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S2	446	AU='WALKER J S'
S3	8	AU='WALKER J.'
S4	3	AU='WALKER J.SAMUEL'
S5	309	AU='WALKER JAY':AU='WALKER JAY S'
S6	88	AU='WALKER, J'
S7	30	AU='WALKER, J SAMUEL'
S8	630	AU='WALKER, J.'
S9	1	AU='WALKER, J. A. S., JR'
S10	109	AU='WALKER, J. S':AU='WALKER, J. SAMUEL, 1946-'
S11	3	AU='WALKER, J., II'
S12	165	AU='WALKER, J.S.'
S13	14	AU='WALKER, JAY'
S14	2	AU='WALKER, JAY S.'
S15	1	AU='WALKER, JAY, 1973-'
S16	505	AU='JORASCH J':AU='JORASCH JAMES A 25 FOREST STREET'
S17	1	AU='JORASCH, JAMES A., 1965-'
S18	1957	S1:S17
S19	902	S18 FROM 347,348,349,350,371
S20	348	IC=G06F-017?
S21	12	CHARGECARD? ? OR CREDITCARD? ? OR BANKCARD? ? OR VISA OR M- ASTERCARD OR AMERICAN()EXPRESS OR CHARGEACCOUNT? ? OR CREDITL- INE? ?

S22 6 S20 AND S21
 S23 191 (CHARGE OR CREDIT OR BANK OR MASTER OR STORE OR SHOP OR ME-
 RCHANT) () (CARD OR ACCOUNT OR LINE OR CONTRACT? ? OR AGREEMENT)
 S24 191 S21 OR S23
 S25 96 S20 AND S24
 S26 466 TERM? ? OR PARAMET? OR INTEREST()RATE OR (MONTHLY OR MINIM-
 UM) () PAYMENT OR TIME OR PERIOD OR CREDIT()LIMIT OR GRACE OR A-
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 S27 74 S25 AND S26
 S28 21 S25(10N)S26
 S29 21 IDPAT (sorted in duplicate/non-duplicate order)
 S30 21 IDPAT (primary/non-duplicate records only)
 S31 1055 S18 NOT S19
 S32 37 S24(10N)S26
 S33 0 S31 AND S32
 S34 1 S24 AND S31
 S35 150 S26 AND S31
 S36 303 NEGO?IATI??? OR BARGAINING OR PARLEY??? OR HAGGL??? OR DIC-
 KER??? OR MODIFY??? OR MODIFI? OR ALTERNATIVE OR FLEXIBLE OR -
 CUSTOM OR CUSTOMI? OR MODIF? OR ADAPT? OR PERSONALI? OR INDIV-
 IDUALI? OR TAILOR???
 S37 21 S35 AND S36
 S38 10 S37 NOT PY>1997
 S39 10 S38 NOT PD=19970313:20050430
 S40 10 RD (unique items)
 S41 31 S30 OR S40

41/3,K/7 (Item 7 from file: 349)
DIALOG(R)File 349:PCT FULLTEXT
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00761437 **Image available**

METHOD AND APPARATUS FOR PROCESSING CREDIT CARD TRANSACTIONS
PROCEDE ET DISPOSITIF PERMETTANT DE TRAITER DES OPERATIONS EFFECTUEES PAR
CARTE DE CREDIT

Patent Applicant/Assignee:

WALKER DIGITAL LLC, Five High Ridge Park, Stamford, CT 06905, US, US
(Residence), US (Nationality), (For all designated states except: US)

Patent Applicant/Inventor:

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US (Nationality), (Designated only for: US)

TULLEY Stephen C, 15 River Place, Stamford, CT 06907, US, US (Residence),
US (Nationality), (Designated only for: US)

TEDESCO Daniel E, Apt. 6, 192 Park Street, New Canaan, CT 06840, US, US
(Residence), US (Nationality), (Designated only for: US)

VAN LUCHENE Andrew S, 9 Greenwood Place, Norwalk, CT 06854, US, US
(Residence), US (Nationality), (Designated only for: US)

Legal Representative:

MASCHOFF Kurt M (et al) (agent), Intellectual Property Department, Walker
Digital Corporation, One High Ridge Park, Stamford, CT 06905-1325, US,
Patent and Priority Information (Country, Number, Date):

Patent: WO 200074011 A2-A3 20001207 (WO 0074011)

Application: WO 2000US12007 20000428 (PCT/WO US0012007)

Priority Application: US 99316546 19990521

Designated States:

(Protection type is "patent" unless otherwise stated - for applications
prior to 2004)

AE AG AL AM AT AU AZ BA BB BG BR BY CA CH CN CR CU CZ DE DK DM DZ EE ES
FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU
LV MA MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT
TZ UA UG US UZ VN YU ZA ZW

(EP) AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE

(OA) BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG

(AP) GH GM KE LS MW SD SL SZ TZ UG ZW

(EA) AM AZ BY KG KZ MD RU TJ TM

Publication Language: English

Filing Language: English

Fulltext Word Count: 12956

Fulltext Availability:

Detailed Description

Claims

Detailed Description

... applied to the customer's financial account (step 1022).

Clearinghouse server 104 then reconciles the **merchant account** and the
customer financial account according to the **terms** set forth by the
particular offer (step 1024), after which process I 000 ends.

Various...

Claim

... ORIGINAL

RETRIEVE CHARGE ADJUSTMENT PURCHASE TOTAL 1021
AMOUNT FROM APPROPRIATE RECORD
OF TRANSACTION DATABASE 1022
RECONCILE **MERCHANT ACCOUNT**
AND CUSTOMER ACCOUNT ACCORDING
TO OFFER **TERMS** 1024
FIG, 10B
/ 16
1100
THANK YOU FOR YOUR PATRONAGE
JOE'S AMERICAN RESTAURANT
637...

41/3,K/8 (Item 8 from file: 349)
DIALOG(R)File 349:PCT FULLTEXT
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00577738 **Image available**
DEVICE AND METHOD FOR PROMOTING THE SELECTION AND USE OF A CREDIT CARD
DISPOSITIF ET PROCEDE PERMETTANT DE PROMOUVOIR LE CHOIX ET L'UTILISATION
D'UNE CARTE DE CREDIT

Patent Applicant/Assignee:

WALKER DIGITAL LLC,
WALKER Jay S,
SCHNEIER Bruce,
MIK Magdalena,

Inventor(s):

WALKER Jay S,
SCHNEIER Bruce,
MIK Magdalena,

Patent and Priority Information (Country, Number, Date):

Patent: WO 200041111 A2 20000713 (WO 0041111)
Application: WO 99US29658 19991214 (PCT/WO US9929658)
Priority Application: US 98223164 19981230

Designated States:

(Protection type is "patent" unless otherwise stated - for applications
prior to 2004)

AE AL AM AT AU AZ BA BB BG BR BY CA CH CN CU CZ DE DK EE ES FI GB GD GE
GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK
MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT UA UG US UZ VN
YU ZA ZW GH GM KE LS MW SD SL SZ TZ UG ZW AM AZ BY KG KZ MD RU TJ TM AT
BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE BF BJ CF CG CI CM GA
GN GW ML MR NE SN TD TG

Publication Language: English

Fulltext Word Count: 9500

Fulltext Availability:

Detailed Description

Detailed Description

... known form of identification used by individuals to have merchandise,
services, etc., billed to a **charge account**. The term "**credit**
card", however, is intended herein to include any type of card carried
by a consumer which...

41/3,K/11 (Item 11 from file: 349)
DIALOG(R)File 349:PCT FULLTEXT

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00576347 **Image available**

METHOD AND APPARATUS FOR PROVIDING CROSS-BENEFITS BASED ON A CUSTOMER
ACTIVITY

PROCEDE ET APPAREIL SERVANT A GENERER DES BENEFICES PARALLELES LIES A
L'ACTIVITE D'UN CLIENT

Patent Applicant/Assignee:

WALKER DIGITAL LLC,
WALKER Jay S,
TEDESCO Daniel E,
TULLEY Stephen C,
PACKES John M Jr,
O'SHEA Deirdre,
BEMER Keith,
JORASCH James A,
ALDERUCCI Dean P,

Inventor(s):

WALKER Jay S,
TEDESCO Daniel E,
TULLEY Stephen C,
PACKES John M Jr,
O'SHEA Deirdre,
BEMER Keith,
JORASCH James A,
ALDERUCCI Dean P,

Patent and Priority Information (Country, Number, Date):

Patent: WO 200039720 A1 20000706 (WO 0039720)
Application: WO 99US19955 19990831 (PCT/WO US9919955)
Priority Application: US 98282747 19981005

Designated States:

(Protection type is "patent" unless otherwise stated - for applications
prior to 2004)

AE AL AM AT AU AZ BA BB BG BR BY CA CH CN CU CZ DE DK EE ES FI GB GD GE
GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK
MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT UA UG US UZ VN
YU ZA ZW GH GM KE LS MW SD SL SZ UG ZW AM AZ BY KG KZ MD RU TJ TM AT BE
CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE BF BJ CF CG CI CM GA GN
GW ML MR NE SN TD TG

Publication Language: English

Fulltext Word Count: 19014

Fulltext Availability:

Detailed Description

Detailed Description

... The fields specify (1) a transaction identifier 620 that uniquely
identifies the transaction, (ii) a **time** 622 of the transaction, (iii)
the items ordered 624, (iv) **credit card** information 626 that may
define a credit card account that was charged to pay for...provided to
the customer if the customer does not fulfill the obligation within the
allotted **time** . For example, if the **credit card** account was
previously charged \$80 (in one or more transactions) in step 1516 for a
...

41/3,K/17 (Item 2 from file: 350)

DIALOG(R)File 350:Derwent WPIX

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014869160 **Image available**
WPI Acc No: 2002-689866/200274
Related WPI Acc No: 2000-236615; 2003-480281
XRPX Acc No: N02-544125

**Customized reward offer processing method for credit card holders,
involves determining performance target associated with financial account
of credit card holder, to evaluate reward offer**

Patent Assignee: WALKER DIGITAL LLC (WALK-N)
Inventor: JINDAL S K; WALKER J S; WEIR-JONES T
Number of Countries: 001 Number of Patents: 001
Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6434534	B1	20020813	US 97921868	A	19970828	200274 B
			US 99422415	A	19991021	

Priority Applications (No Type Date): US 97921868 A 19970828; US 99422415 A 19991021

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
US 6434534	B1	17	G06F-017/60	Cont of application US 97921868	
				Cont of patent US 6018718	

Abstract (Basic):

... A performance target associated with a financial account of a
credit card holder, is determined. A reward offer and a target
period are transmitted to the card holder, if he/she behaves according
to the performance target...

41/3,K/18 (Item 3 from file: 350)
DIALOG(R)File 350:Derwent WPIX
(c) 2005 Thomson Derwent. All rts. reserv.

014649435 **Image available**
WPI Acc No: 2002-470139/200250
Related WPI Acc No: 1999-590661
XRPX Acc No: N02-371080

**Parameter negotiating method for customizing credit accounts, involves
comparing requested account parameter with set of available parameters
for submitting price to customer**

Patent Assignee: WALKER DIGITAL LLC (WALK-N)
Inventor: JORASCH J A; WALKER J S
Number of Countries: 001 Number of Patents: 001
Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6374230	B1	20020416	US 97815224	A	19970312	200250 B
			US 99365644	A	19990802	

Priority Applications (No Type Date): US 97815224 A 19970312; US 99365644 A 19990802

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
US 6374230	B1	14	G06F-017/60	Cont of application US 97815224	
				Cont of patent US 5970478	

Abstract (Basic):

... A request having requested account **parameter** is received for
desired **credit account** . The price for the proposed **credit
account** is calculated, by comparing requested account **parameter** with

set of available parameters. The proposal of price is then submitted to a customer.

41/AA,AN,AZ,TI/1 (Item 1 from file: 349)
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00949462

METHODS AND SYSTEMS FOR FACILITATING GAME PLAY AT A GAMING DEVICE BY MEANS
OF THIRD PARTY OFFERS

PROCEDES ET SYSTEMES FACILITANT LE JEU SUR UN APPAREIL DE JEU GRACE A DES
OFFRES DE TIERCES PARTIES

Application: WO 2002US11799 20020411 (PCT/WO US0211799)

41/AA,AN,AZ,TI/2 (Item 2 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00851721

SYSTEM TO PROVIDE DISCOUNT AMOUNTS FOR PERFORMANCE OF WORK ASSIGNMENTS
SYSTEME CONCU POUR FOURNIR DES RABAIS POUR L'EXECUTION D'ATTRIBUTIONS DE
TACHES

Application: WO 2001US14236 20010502 (PCT/WO US0114236)

41/AA,AN,AZ,TI/3 (Item 3 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00843152

ENTERTAINMENT LAYER OVERLAID ON ONLINE TRANSACTIONS
COUCHE DE DIVERTISSEMENT ACCOMPAGNANT DES TRANSACTIONS EN LIGNE

Application: WO 2001US9806 20010327 (PCT/WO US0109806)

41/AA,AN,AZ,TI/4 (Item 4 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00829901

SYSTEM FOR UTILIZING REDEMPTION INFORMATION
SYSTEME D'UTILISATION D'INFORMATIONS DE RACHAT

Application: WO 2001US5829 20010223 (PCT/WO US0105829)

41/AA,AN,AZ,TI/5 (Item 5 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00790588

SYSTEMS AND METHODS TO PROVIDE A PRODUCT TO A CUSTOMER BEFORE A FINAL
TRANSACTION TERM VALUE IS ESTABLISHED

SYSTEMES ET PROCEDES SERVANT A LIVRER UN PRODUIT A UN CLIENT AVANT
L'ETABLISSEMENT DU TERME FINAL DE LA TRANSACTION

Application: WO 2000US25394 20000915 (PCT/WO US0025394)

41/AA,AN,AZ,TI/6 (Item 6 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00766038

PURCHASING SYSTEMS AND METHODS WHEREIN A BUYER TAKES POSSESSION AT A
RETAILER OF A PRODUCT PURCHASED USING A COMMUNICATION NETWORK

SYSTEMES ET PROCEDES D'ACHAT OU UN ACHETEUR PREND POSSESSION CHEZ UN

DETAILLANT D'UN PRODUIT ACHETE AU MOYEN D'UN RESEAU DE COMMUNICATION
Application: WO 2000US12640 20000509 (PCT/WO US0012640)

41/AA,AN,AZ,TI/7 (Item 7 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00761437
METHOD AND APPARATUS FOR PROCESSING CREDIT CARD TRANSACTIONS
PROCEDE ET DISPOSITIF PERMETTANT DE TRAITER DES OPERATIONS EFFECTUEES PAR
CARTE DE CREDIT
Application: WO 2000US12007 20000428 (PCT/WO US0012007)

41/AA,AN,AZ,TI/8 (Item 8 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00577738
DEVICE AND METHOD FOR PROMOTING THE SELECTION AND USE OF A CREDIT CARD
DISPOSITIF ET PROCEDE PERMETTANT DE PROMOUVOIR LE CHOIX ET L'UTILISATION
D'UNE CARTE DE CREDIT
Application: WO 99US29658 19991214 (PCT/WO US9929658)

41/AA,AN,AZ,TI/9 (Item 9 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00577736
SYSTEM AND METHOD FOR NEGATIVE RETROACTIVE DISCOUNTS
SYSTEME ET METHODE CONCERNANT DES PENALISATIONS RETROACTIVES SUR REMISES
Application: WO 99US28702 19991202 (PCT/WO US9928702)

41/AA,AN,AZ,TI/10 (Item 10 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00576354
METHOD AND APPARATUS FOR PROVIDING CROSS BENEFITS AND PENALTIES
PROCEDE ET DISPOSITIF SERVANT A PRODUIRE DES AVANTAGES ET DES PENALITES
CROISES
Application: WO 99US30504 19991221 (PCT/WO US9930504)

41/AA,AN,AZ,TI/11 (Item 11 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00576347
METHOD AND APPARATUS FOR PROVIDING CROSS-BENEFITS BASED ON A CUSTOMER
ACTIVITY
PROCEDE ET APPAREIL SERVANT A GENERER DES BENEFICES PARALLELES LIES A
L'ACTIVITE D'UN CLIENT
Application: WO 99US19955 19990831 (PCT/WO US9919955)

41/AA,AN,AZ,TI/12 (Item 12 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00535091

**METHOD AND APPARATUS FOR PROVIDING CROSS-BENEFITS VIA A CENTRAL AUTHORITY
PROCEDE ET APPAREIL PERMETTANT D'OBTENIR DES BENEFICES CROISES VIA UNE
AUTORITE CENTRALE**

Application: WO 99US13819 19990618 (PCT/WO US9913819)

41/AA,AN,AZ,TI/13 (Item 13 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00530664
**SYSTEM AND METHOD PROVIDING A RESTAURANT MENU DYNAMICALLY GENERATED BASED
ON REVENUE MANAGEMENT INFORMATION**

**SYSTEME ET PROCEDE PERMETTANT DE CREER UN MENU DE RESTAURANT SUR UNE BASE
DYNAMIQUE EN FONCTION D'INFORMATIONS SUR LA GESTION DES RECETTES**

Application: WO 99US10882 19990518 (PCT/WO US9910882)

41/AA,AN,AZ,TI/14 (Item 14 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00470876
**SYSTEM FOR SYNDICATION OF INSURANCE
SYSTEME DE SYNDICAT D'ASSURANCE**

Application: WO 98US13720 19980701 (PCT/WO US9813720)

41/AA,AN,AZ,TI/15 (Item 15 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00419900
**CONDITIONAL PURCHASE OFFER MANAGEMENT SYSTEMS
SYSTEMES DE GESTION D'OFFRES D'ACHAT CONDITIONNELLES**
Application: WO 97US15492 19970904 (PCT/WO US9715492)

41/AA,AN,AZ,TI/16 (Item 1 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

015358875
WPI Acc No: 2003-419813/
Product sale management method for aging products, involves evaluating
offer period during which completion of payment using credit card
is identified by customer identifier
Local Applications (No Type Date): US 97943965 A 19971006; US 2000563715 A
20000502; US 2002279303 A 20021022
Priority Applications (No Type Date): US 97943965 A 19971006; US 2000563715
A 20000502; US 2002279303 A 20021022

41/AA,AN,AZ,TI/17 (Item 2 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

014869160
WPI Acc No: 2002-689866/
Customized reward offer processing method for credit card holders,
involves determining performance target associated with financial account
of credit card holder, to evaluate reward offer
Local Applications (No Type Date): US 97921868 A 19970828; US 99422415 A

19991021
Priority Applications (No Type Date): US 97921868 A 19970828; US 99422415 A
19991021

41/AA,AN,AZ,TI/18 (Item 3 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

014649435
WPI Acc No: 2002-470139/
Parameter negotiating method for customizing credit accounts, involves comparing requested account parameter with set of available parameters for submitting price to customer
Local Applications (No Type Date): US 97815224 A 19970312; US 99365644 A
19990802
Priority Applications (No Type Date): US 97815224 A 19970312; US 99365644 A
19990802

41/AA,AN,AZ,TI/19 (Item 4 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

014416333
WPI Acc No: 2002-237036/
Installment plan option providing method for credit card transaction, involves receiving installment plan identifier based on transmitted financial account identifier and purchase price
Local Applications (No Type Date): US 97822709 A 19970321; US 97920116 A
19970826; US 97946508 A 19971007; US 99264379 A 19990305
Priority Applications (No Type Date): US 97946508 A 19971007; US 97822709 A
19970321; US 97920116 A 19970826; US 99264379 A 19990305

41/AA,AN,AZ,TI/20 (Item 5 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

014275953
WPI Acc No: 2002-096655/
Installment plan options providing apparatus for credit card users, has central controller which generates installment plan identifier, based on received price and financial account identifier
Local Applications (No Type Date): US 97822709 A 19970321; US 97920116 A
19970826; US 97946508 A 19971007; US 2000490898 A 20000125
Priority Applications (No Type Date): US 97946508 A 19971007; US 97822709 A
19970321; US 97920116 A 19970826; US 2000490898 A 20000125

41/AA,AN,AZ,TI/21 (Item 6 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

012784435
WPI Acc No: 1999-590661/
Credit card account data processor for issue and buy of credit card in bank
Local Applications (No Type Date): US 97815224 A 19970312
Priority Applications (No Type Date): US 97815224 A 19970312

41/AA,AN,AZ,TI/22 (Item 1 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

4490879 INSPEC Abstract Number: C9311-1290F-048
Title: The single- period inventory problem with triangular demand
distribution

41/AA,AN,AZ,TI/23 (Item 2 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

03941790 INSPEC Abstract Number: A91102465
Title: Liquid-metal flows in sliding electrical contacts with arbitrary
magnetic-field orientations

41/AA,AN,AZ,TI/24 (Item 3 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

03758648 INSPEC Abstract Number: B90074729, C90069220
Title: A new bit reversal algorithm

41/AA,AN,AZ,TI/25 (Item 4 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

03054702 INSPEC Abstract Number: B88007647
Title: It's time for better high-density packaging

41/AA,AN,AZ,TI/26 (Item 5 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

02663253 INSPEC Abstract Number: A86066567
Title: Non-uniformities in transient adaptation . I. Unrestricted
background fields (visual perception)

41/AA,AN,AZ,TI/27 (Item 6 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

02008650 INSPEC Abstract Number: A83030809
Title: Preserving the free energy in a Migdal-Kadanoff approximation for
the q-state Potts model

41/AA,AN,AZ,TI/28 (Item 7 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

01971746 INSPEC Abstract Number: A83005758
Title: Exact preservation of the free energy in a modified

Migdal-Kadanoff approximation

41/AA,AN,AZ,II/29 (Item 8 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

00951235 INSPEC Abstract Number: A76071923
Title: Periodic fluid transients in rectangular ducts with transverse
magnetic fields. II

41/AA,AN,AZ,II/30 (Item 1 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00030076 75-08492
FLEXIBLE WORKING HOURS IN TWO BRITISH GOVERNMENT OFFICES

41/AA,AN,AZ,II/31 (Item 1 from file: 484)
DIALOG(R)File 484:(c) 2005 ProQuest. All rts. reserv.

02319867
The origins of the Cold War in United States history textbooks -- America
and Its People by James Kirby Martin, Randy Roberts, Steven Mintz, Linda
O. McMurry and James H. Jones / America by George Brown Tindall with
David E. Shi / and others

? show files;ds
 File 347:JAPIO Nov 1976-2004/Nov(Updated 050309)
 (c) 2005 JPO & JAPIO
 File 350:Derwent WPIX 1963-2005/UD,UM &UP=200518
 (c) 2005 Thomson Derwent
 File 371:French Patents 1961-2002/BOPI 200209
 (c) 2002 INPI. All rts. reserv.

*bibliographic
 patent files*

Set	Items	Description
S1	797068	CHARGE OR CREDIT OR BANK OR MASTER OR STORE OR SHOP OR MERCHANT
S2	1543995	CARD OR ACCOUNT OR LINE OR CONTRACT? ? OR AGREEMENT
S3	386	CHARGECARD? ? OR CREDITCARD? ? OR BANKCARD? ? OR VISA OR M- ASTERCARD OR AMERICAN()EXPRESS OR CHARGEACCOUNT? ? OR CREDITLINE? ?
S4	7689	UNHAPPY OR UNSATISF? OR DISSATISFIED OR DISPUT??? OR COMPL- AIN??? OR ("NOT" OR NON OR UN) () (HAPPY OR SATISFIED OR CONTEN- T?? OR PLEASED) OR DISCONTENT?? OR DISPLEASED
S5	1399876	NEGO?IATI??? OR BARGAINING OR PARLEY??? OR HAGGL??? OR DIC- KER??? OR MODIFY??? OR MODIFI? OR ALTERNATIVE OR FLEXIBLE OR - CUSTOM OR CUSTOMI? OR MODIF? OR ADAPT? OR PERSONALI? OR INDIV- IDUALI? OR TAILOR???
S6	3335946	TERM? ? OR PARAMET? OR INTEREST()RATE OR (MONTHLY OR MINIM- UM) ()PAYMENT OR TIME OR PERIOD OR CREDIT()LIMIT OR GRACE OR A- MNESTY OR LATE()FEE OR TIMESPAN? ? OR DURATION?
S7	22799	S3 OR (S1(2N)S2)
S8	16	S4(S) (S5(10N)S6)
S9	0	S7(S)S8
S10	31467	S5(10N)S6
S11	32	S7(S)S10
S12	317048	IC=G06F-017?
S13	16	S11 AND S12
S14	0	S4 AND S11
S15	16	IDPAT S13 (sorted in duplicate/non-duplicate order)
S16	16	IDPAT S13 (primary/non-duplicate records only)

16/2/1 (Item 1 from file: 350)
DIALOG(R)File 350:Derwent WPIX
(c) 2005 Thomson Derwent. All rts. reserv.

016290112 **Image available**
WPI Acc No: 2004-448007/200442
XRPX Acc No: N04-354327

Pick-up and delivery system of passengers and luggage over distributed network, includes scalable system which supports multiple online service providers of any size and from any location in the world

Patent Assignee: ROBERTSON S C (ROBE-I); SCHNEIDER M H (SCHN-I)

Inventor: ROBERTSON S C; SCHNEIDER M H

Number of Countries: 001 Number of Patents: 001

Basic Patent:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20040102979	A1	20040527	US 200257048	A	20020123	200442 B

Priority Applications (No Type Date): US 200257048 A 20020123

Abstract (Basic): US 20040102979 A1

NOVELTY - Multiple service provider sites are connected to multiple user computers over a distributed network and provide on-line service to users. A mySkycap site is connected to the service provider sites and user computers and includes several databases e.g. traveler database. A scalable system supports multiple online service providers of any size and from any location in the world.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for the following:

(a) Method for consolidating multiple travel segment reservations into a single itinerary confirmation; and

(b) An apparatus comprising a mySkycap server.

USE - For use in managing luggage handling services across multiple service partners and destinations, e.g. train, bus and aircraft. For large families with multiple number of children.

ADVANTAGE - Allows for the pick-up and drop of the luggage at the convenience of the traveler and allows them to travel without worrying about their luggage, and saves time of dealing with the luggage. Permits travelers and service providers to interact in secure environment. Permits convenient travel planning and efficient use of time. Permits scheduling and negotiation of individual travel segments and reduce the possibility of **credit card** fraud.

DESCRIPTION OF DRAWING(S) - The figure shows the flowchart of the system.

pp; 65 DwgNo 2/45

Title Terms: PICK; UP; DELIVER; SYSTEM; PASSENGER; LUGGAGE; DISTRIBUTE; NETWORK; SYSTEM; SUPPORT; MULTIPLE; SERVICE; SIZE; LOCATE; WORLD

Derwent Class: T01; W06; X22; X23

International Patent Class (Main): **G06F-017/60**

File Segment: EPI

Manual Codes (EPI/S-X): T01-J05B4P; T01-N01A2E; W06-B02A5; X22-P05A; X22-X; X23-C02

? t s16/3,k/6,7,9,11

16/3,K/6 (Item 6 from file: 350)
DIALOG(R)File 350:Derwent WPIX
(c) 2005 Thomson Derwent. All rts. reserv.

014649435 **Image available**
WPI Acc No: 2002-470139/200250

Related WPI Acc No: 1999-590661
XRPX Acc No: N02-371080

X instant
applic.

**Parameter negotiating method for customizing credit accounts, involves
comparing requested account parameter with set of available parameters
for submitting price to customer**

Patent Assignee: WALKER DIGITAL LLC (WALK-N)

Inventor: JORASCH J A; WALKER J S

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6374230	B1	20020416	US 97815224	A	19970312	200250 B
			US 99365644	A	19990802	

Priority Applications (No Type Date): US 97815224 A 19970312; US 99365644 A
19990802

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
US 6374230	B1	14		G06F-017/60	Cont of application US 97815224 Cont of patent US 5970478

Abstract (Basic):

... The credit card holders are benefited by enabling them to find a
card with credit **terms** that they desired and to **modify** those **terms**
as their needs change...

International Patent Class (Main): **G06F-017/60**

16/3,K/7 (Item 7 from file: 350)

DIALOG(R)File 350:Derwent WPIX

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014551529 **Image available**

WPI Acc No: 2002-372232/200240

XRPX Acc No: N02-290883

**Computer-based method for determining individually customized loan terms
for a customer, uses amount, term and type of customer loan required as
well as data on customer credit score, debt burden and collateral**

Patent Assignee: AMERICAN EXPRESS CO (AMEX-N)

Inventor: ERICKSEN B

Number of Countries: 097 Number of Patents: 003

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 200229521	A2	20020411	WO 2001US31257	A	20011005	200240 B
AU 200211466	A	20020415	AU 200211466	A	20011005	200254
US 20020123960	A1	20020905	US 2000238186	A	20001005	200260
			US 2001972785	A	20011005	

Priority Applications (No Type Date): US 2000238186 P 20001005; US
2001972785 A 20011005

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
WO 200229521	A2	E	36	G06F-000/00	

Designated States (National): AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA
CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN
IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ
PH PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW

Designated States (Regional): AT BE CH CY DE DK EA ES FI FR GB GH GM GR
IE IT KE LS LU MC MW MZ NL OA PT SD SE SL SZ TR TZ UG ZW

AU 200211466 A G06F-000/00 Based on patent WO 200229521

US 20020123960 A1 G06F-017/60 Provisional application US 2000238186

Abstract (Basic):

... For use by banks, credit card companies and the like for
offering loans having **customized** loan **terms** .

...International Patent Class (Main): **G06F-017/60**

16/3,K/9 (Item 9 from file: 350)
DIALOG(R)File 350:Derwent WPIX
(c) 2005 Thomson Derwent. All rts. reserv.

013576265 **Image available**
WPI Acc No: 2001-060472/200107
Related WPI Acc No: 2002-672921; 2003-512941
XRPX Acc No: N01-045270

**Electronic commerce and banking system for credit card payment system,
includes web bank in which access parameters are customized by web
bank owner to control degree of access provided to third party**

Patent Assignee: COHEN M E (COHE-I)

Inventor: COHEN M E

Number of Countries: 090 Number of Patents: 002

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 200055793	A1	20000921	WO 2000US7457	A	20000320	200107 B
AU 200037659	A	20001004	AU 200037659	A	20000320	200107

Priority Applications (No Type Date): US 99165231 P 19991111; US 99125008 P
19990318; US 99280483 A 19990330; US 99130599 P 19990422; US 99130600 P
19990422; US 99138428 P 19990610; US 99139167 P 19990615; US 99369902 A
19990806; US 99161283 P 19991025

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 200055793 A1 E 103 G06F-017/60

Designated States (National): AE AL AM AT AU AZ BA BB BG BR BY CA CH CN
CR CU CZ DE DK DM EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP
KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX NO NZ PL PT RO RU SD SE
SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW

Designated States (Regional): AT BE CH CY DE DK EA ES FI FR GB GH GM GR
IE IT KE LS LU MC MW NL OA PT SD SE SL SZ TZ UG ZW

AU 200037659 A Based on patent WO 200055793

... **commerce and banking system for credit card payment system, includes
web bank in which access parameters are customized by web bank owner
to control degree of access provided to third party**

Abstract (Basic):

... third party is provided with some degree of access to web owners
bank account. Access **parameters** associated with web bank are
customizable by web bank owner to control degree of access provided to
third party.

International Patent Class (Main): **G06F-017/60**

16/AN,AZ,TI/1 (Item 1 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

016290112

Pick-up and delivery system of passengers and luggage over distributed network, includes scalable system which supports multiple online service providers of any size and from any location in the world
Local Applications (No Type Date): US 200257048 A 20020123
Priority Applications (No Type Date): US 200257048 A 20020123

16/AN,AZ,TI/2 (Item 2 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

016269443

Method for processing payment slip of credit card based on internet
Local Applications (No Type Date): KR 200246274 A 20020806
Priority Applications (No Type Date): KR 200246274 A 20020806

16/AN,AZ,TI/3 (Item 3 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

015451690

Alternative payment apparatus using barcode stored in mobile communication terminal, in which alternative payer transfers certain amount of money from credit card to barcode to allow for purchase of goods and services
Local Applications (No Type Date): WO 2002KR2256 A 20021130; KR 200175637 A 20011201; AU 2002365788 A 20021130
Priority Applications (No Type Date): KR 200175637 A 20011201

16/AN,AZ,TI/4 (Item 4 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

015420692

Payment apparatus using transfer card, in which certain amount of money within credit limit of credit card owned by guardian or alternative payer of person ineligible to be issued with credit card is assigned to transfer card
Local Applications (No Type Date): WO 2002KR2257 A 20021130; KR 200175638 A 20011201; AU 2002365789 A 20021130
Priority Applications (No Type Date): KR 200175638 A 20011201

16/AN,AZ,TI/5 (Item 5 from file: 350)
DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

015021120

Payment settlement method for credit card transactions, involves providing transmitting agency data containing transmission origin to credit card firm, by value added communication method
Local Applications (No Type Date): JP 200197699 A 20010329
Priority Applications (No Type Date): JP 200197699 A 20010329

16/AN,AZ,TI/6 (Item 6 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

014649435

Parameter negotiating method for customizing credit accounts, involves comparing requested account parameter with set of available parameters for submitting price to customer

Local Applications (No Type Date): US 97815224 A 19970312; US 99365644 A 19990802

Priority Applications (No Type Date): US 97815224 A 19970312; US 99365644 A 19990802

16/AN,AZ,TI/7 (Item 7 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

014551529

Computer-based method for determining individually customized loan terms for a customer, uses amount, term and type of customer loan required as well as data on customer credit score, debt burden and collateral

Local Applications (No Type Date): WO 2001US31257 A 20011005; AU 200211466 A 20011005; US 2000238186 A 20001005; US 2001972785 A 20011005

Priority Applications (No Type Date): US 2000238186 P 20001005; US 2001972785 A 20011005

16/AN,AZ,TI/8 (Item 8 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

014550827

Managing apparatus for shop communication terminal has keyboard and mobile phone

Local Applications (No Type Date): WO 2001JP6299 A 20010719; WO 2001JP6299 A 20010719; US 200289122 A 20020322; WO 2001JP6299 A 20010719; JP 2002515653 A 20010719

Priority Applications (No Type Date): JP 2000226163 A 20000727

16/AN,AZ,TI/9 (Item 9 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

013576265

Electronic commerce and banking system for credit card payment system, includes web bank in which access parameters are customized by web bank owner to control degree of access provided to third party

Local Applications (No Type Date): WO 2000US7457 A 20000320; AU 200037659 A 20000320

Priority Applications (No Type Date): US 99165231 P 19991111; US 99125008 P 19990318; US 99280483 A 19990330; US 99130599 P 19990422; US 99130600 P 19990422; US 99138428 P 19990610; US 99139167 P 19990615; US 99369902 A 19990806; US 99161283 P 19991025

16/AN,AZ,TI/10 (Item 10 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

013514717

Computer implemented credit account monitoring method involves monitoring account transaction of customer with reference to threshold level and

alerts customer on reaching threshold

Local Applications (No Type Date): WO 2000US2707 A 20000202; AU 200033559 A 20000202
Priority Applications (No Type Date): US 2000495732 A 20000201; US 99118329 P 19990203

16/AN,AZ,TI/11 (Item 11 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

013327208

Contractual, administrative and financial records processing system for consumer product purchase transaction, allows user to view and select deal modules, and to input deal attributes using interface

Local Applications (No Type Date): WO 2000US884 A 20000113; AU 200026114 A 20000113; EP 2000904339 A 20000113; WO 2000US884 A 20000113
Priority Applications (No Type Date): US 99115667 P 19990113

16/AN,AZ,TI/12 (Item 12 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

012866182

Reverse mortgage loan calculating method

Local Applications (No Type Date): US 97787426 A 19970122
Priority Applications (No Type Date): US 97787426 A 19970122

16/AN,AZ,TI/13 (Item 13 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

012784435

Credit card account data processor for issue and buy of credit card in bank

Local Applications (No Type Date): US 97815224 A 19970312
Priority Applications (No Type Date): US 97815224 A 19970312

16/AN,AZ,TI/14 (Item 14 from file: 350)

DIALOG(R)File 350:(c) 2005 Thomson Derwent. All rts. reserv.

011440731

Transactions processing method - involves receiving card and checking entered identification number, permitting user to select transaction and receiving additional required cards which numbers are entered only if strictly necessary

Local Applications (No Type Date): GB 974388 A 19970303; JP 9645824 A 19960304; CA 2198793 A 19970228; GB 974388 A 19970303; US 97810470 A 19970304; JP 9645824 A 19960304; JP 2000273537 A 19960304; CA 2198793 A 19970228
Priority Applications (No Type Date): JP 9645824 A 19960304; JP 2000273537 A 19960304

16/AN,AZ,TI/15 (Item 15 from file: 347)

DIALOG(R)File 347:(c) 2005 JPO & JAPIO. All rts. reserv.

08100602

INFORMATION DELIVERY SYSTEM AND METHOD, AND PROGRAM FOR MAKING COMPUTER
IMPLEMENT THE METHOD

APPL. NO.: 2002-382547 [JP 2002382547]

16/AN,AZ,TI/16 (Item 16 from file: 347)
DIALOG(R)File 347:(c) 2005 JPO & JAPIO. All rts. reserv.

07522538
METHOD AND SYSTEM FOR SELLING AND CHARGING FOR CONTENTS, ARTICLE AND
SERVICE BY POINT

APPL. NO.: 2001-201005 [JP 2001201005]

? show files;ds

File 348:EUROPEAN PATENTS 1978-2005/Feb W04

(c) 2005 European Patent Office

File 349:PCT FULLTEXT 1979-2005/UB=20050317,UT=20050310

(c) 2005 WIPO/Univentio

*full text
patent file*

Set	Items	Description
S1	465346	CHARGE OR CREDIT OR BANK OR MASTER OR STORE OR SHOP OR MER- CHANT
S2	856750	CARD OR ACCOUNT OR LINE OR CONTRACT? ? OR AGREEMENT
S3	5008	CHARGECARD? ? OR CREDITCARD? ? OR BANKCARD? ? OR VISA OR M- ASTERCARD OR AMERICAN()EXPRESS OR CHARGEACCOUNT? ? OR CREDITL- INE? ?
S4	44913	UNHAPPY OR UNSATISF? OR DISSATISFIED OR DISPUT??? OR COMPL- AIN??? OR ("NOT" OR NON OR UN)() (HAPPY OR SATISFIED OR CONTEN- T?? OR PLEASED) OR DISCONTENT?? OR DISPLEASED
S5	1325688	NEGO?IATI??? OR BARGAINING OR PARLEY??? OR HAGGL??? OR DIC- KER??? OR MODIFY??? OR MODIFI? OR ALTERNATIVE OR FLEXIBLE OR - CUSTOM OR CUSTOMI? OR MODIF? OR ADAPT? OR PERSONALI? OR INDIV- IDUALI? OR TAILOR???
S6	1375323	TERM? ? OR PARAMET? OR INTEREST()RATE OR (MONTHLY OR MINIM- UM)()PAYMENT OR TIME OR PERIOD OR CREDIT()LIMIT OR GRACE OR A- MNESTY OR LATE()FEE OR TIMESPAN? ? OR DURATION?
S7	27961	S3 OR (S1(2N)S2)
S8	412	S4(S) (S5(10N)S6)
S9	55	S7(S)S8
S10	49793	IC=G06F-017?
S11	32	S9 AND S10
S12	5	S7(20N)S8
S13	162	S4(30N) (S5(7N)S6)
S14	6	S7(S)S13
S15	48	S7 AND S13
S16	15	S9 AND S15
S17	18	S12 OR S14 OR S16
S18	18	IDPAT (sorted in duplicate/non-duplicate order)
S19	18	IDPAT (primary/non-duplicate records only)

19/3,K/5 (Item 5 from file: 349)
DIALOG(R)File 349:PCT FULLTEXT
(c) 2005 WIPO/Univentio. All rts. reserv.

01008578 **Image available**

**SYSTEM AND METHOD FOR ESTABLISHING OR MODIFYING AN ACCOUNT WITH USER
SELECTABLE TERMS**

**SYSTEME ET PROCEDE POUR ETABLIR OU MODIFIER UN COMPTE AVEC DES TERMES
SELECTIONNABLES PAR L'UTILISATEUR**

Patent Applicant/Assignee:

FIRST USA BANK N A, Three Christina Centre, 201 North Walnut Street,
Wilmington, DE 19801, US, US (Residence), US (Nationality)

Inventor(s):

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EHMAN Karen R, 2 Beacon Lane, Newark, DE 19711, US,
FREDMAN Marc L, 441 E. Erie -Apt. 3611, Chicago, IL 60611, US,
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60201-3830, US.

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JACOBS Ron, 2311 Hilltop Road, Wilmington, DE 19810, US,
SCHMITT Donald H, 10 Pheasants Ridge North, Greenville, DE 19807, US,
BARRETT Donna W, 1 Nest Court, Wilmington, DE 19807, US,
FILAK Douglas A, 609 Aberdeen Road, Kennett Square, PA 19348, US,

Legal Representative:

SCOTT Thomas J Jr (et al) (agent), Intellectual Property Department,
Hunton & Williams, 1900 K Street. N.W., Suite 1200, Washington, DC
20006-1109, US,

Patent and Priority Information (Country, Number, Date):

Patent: WO 200338561 A2-A3 20030508 (WO 0338561)
Application: WO 2002US34870 20021031 (PCT/WO US02034870)
Priority Application: US 2001330871 20011101

Designated States:

(Protection type is "patent" unless otherwise stated - for applications
prior to 2004)

AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ
EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR
LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT RO RU SD SE SG SI

SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZM ZW

(EP) AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LU MC NL PT SE SK TR

(OA) BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG

(AP) GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW

(EA) AM AZ BY KG KZ MD RU TJ TM

Publication Language: English

Filing Language: English

Fulltext Word Count: 15220

Fulltext Availability:

Detailed Description

Claims

English Abstract

The invention is directed to method of electronically receivinf data from
a **credit card** trasnaction processing entity.

Detailed Description

... or features. The terms or features may include, for example in the case of a **credit card**, the annual percentage rate (APR), the credit limit (also referred to as the "**credit line**"), the annual fee, the card design, and/ or a rewards program. The account holder typically has no opportunity to negotiate or **modify** the **terms** of the account, but rather must accept the **terms** of an account as offered by the financial institution. If the account holder is **dissatisfied** with one or more of the **terms**, there is no effective means of **modifying** those **terms**. Accordingly, known methods and systems for providing accounts in some respects do not fully satisfy...specify various preferred terms such as cost (e.g., APR and annual fee), rewards programs, **card** design, affiliates, **credit line**, servicing options, and payment options, among others. The financial services provider issuing the account, e... the invention;

[00171 Figure 7 is a diagram of the entities involved in a typical **credit card** transaction; and [00181 Figure 8 is a flow chart which illustrates a method according to...consumer and business loans, and revolving and nonrevolving loans. Particular examples of loan accounts include **credit card** accounts, which are typically unsecured consumer revolving loans and mortgage accounts, which are typically nonrevolving...connection with the account, such as interest and various fees. In the case of a **credit card account**, the terms of the account typically include the interest rate specified as an annual percentage... type category may include a list of the following available terms related to, for example, **credit card** products: titanium, platinum, signature, smart card, gold, and stored value. The cost category may include...a number of accounts and associated account terms, such as, in the case of a **credit card**, product type, introductory APR, subsequent APR, annual fee, image of the card design, rewards program...ask the user to specify what feature is most important to the user in a **credit card** from a number of choices which include, for example, rewards, low rates, high **credit line**, technology, or special interest groups. A second question may ask ...sends to that user. For example, an account provider may recommend an American Medical Association **Visa** Platinum card for doctors.

[00521 After the user has made his or her selections, the...example, an account provider may allow users to customize a limited number of terms in **credit card** accounts only. Alternatively, an account provider may allow users to customize most or all terms...For example the user may select an unsecured revolving business loan (e.g., a business **credit card**) or a secured nonrevolving consumer loan (e.g., a home mortgage). If the user initially...the account provider. For example, the user may define a desired transaction platform such as **VISA**, **MasterCard**, **American Express**, Discover, Private Label, PLUS, NYCE, MAC, Cirrus, or ACH, which service **credit card** and debit card transactions. The user may also define a desired authorization vehicle, i.e...credit limit. This feature may be desirable to certain users who wish to limit their **credit line** for protection in the event of fraudulent use of their card, or for reasons relating...predetermined time period. For example, the user may agree to charge \$15,000 on a **credit card** within 12 months in ... an organization which the account holder holds in high regard. In the case of a **credit card account**, the design of the card may display the affiliated second entity prominently. Thus, the card...activity. Figure 7 is a diagram showing the entities which are typically involved in a **credit card** transaction. A **merchant** 400 **contracts** for the services of an acquiring processor 410

to process **credit card** transactions of the merchant. When a cardholder wishes to purchase an item, data on the...

...410 seeks authorization from the issuing bank 420, i.e., the bank which issued the **credit card** to the card holder. Upon receiving authorization from the issuing bank 420, the acquiring processor...410 that the goods have been delivered, allowing the acquiring processor 410 to credit the **merchant's account** and, upon request from the merchant, to deposit payment into the **merchant's account** at the **merchant bank** 430.

{00891 According to an exemplary embodiment of the invention, immediately upon completing a...

Claim

... the account over a predetermined time period.

82 The method of claim 79, wherein the **account** is a **credit card account**, and the method further comprises the step of allocating account points for payment in full of a monthly balance.

83 The method of claim 79, wherein the **account** is a **credit card account**, and the method further comprises the step of deducting account points in lieu of applying a service **charge** to the **account**.

84 The method of claim 79, further comprising the step of converting at least of...more affiliates of the account.

88 A method of controlling a credit limit on a **credit card account** comprising the steps of receiving from the user a first credit limit which is applicable to transactions executed by the user with the **credit card** defined by a first transaction characteristic; receiving from the user a second credit limit which is applicable to transactions executed by the user with the **credit card** defined by a second transaction characteristic; and controlling transactions of the user based on the...a second time period.

94 A method comprising the steps of electronically receiving data from a **credit card** transaction processing entity relating to a transaction immediately subsequent to completion of the transaction; and ...is an existing account. 110. The method of claim 100, wherein the **account** is a **credit card account**, and the method further comprises the step of displaying a representation of the second entity...wherein each population segment has an associated credit risk. 123. A method of providing a **credit account** to a user comprising the steps of
(a) receiving from the user a maximum periodic fee value;
(b) sending the user a set of available terms for the **credit account** which are available based on the maximum periodic fee value;
(c) receiving from the user...

...available terms; (d) sending to the user an updated set of available terms for the **credit account** based on the selected term; and
(e) receiving from the user an indication of acceptance of the **credit account**. 124. The method of claim 123, further comprising the step of indicating an unavailability of...method of claim 123, wherein one term in the set of available terms comprises a **credit card** type. 130. The

method of claim 123, wherein ...set of available terms sent to the user.
 . The method of claim 123, wherein the **credit account** accepted by the user is a predefined account. 134. The method of claim 123, wherein the available terms for the **credit account** are based in part on a credit history of the user. 135. The ...function of the extent of usage of the account. 137. A method of providing a **credit account** to a user comprising the steps of
 sending to the user a set of available terms for the **credit account** ;
 receiving from the user a first cost term for the **credit account** ;
 calculating ...claim 137, further comprising the step of categorizing the set of available terms for the **credit account** . 141. The method of claim 140, wherein a first category ...in part on a credit history of the user. 144. A method of providing a **credit card account** to a user comprising the steps of sending to the user a plurality of combinations of...comprising the step of receiving from the user at least one of a user selected **credit line** , an affiliate, and a rewards program. 147. A method of defining an account for a...

19/3,K/7 (Item 7 from file: 349)

DIALOG(R)File 349:PCT FULLTEXT

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00844335 **Image available**

AUTOMATED COMPLAINT MANAGEMENT SYSTEM

SYSTEME AUTOMATISE DE GESTION DE PLAINTES

Patent Applicant/Inventor:

POMERANCE Brenda, 260 West 52 St., Apartment 27B, New York, NY 10019, US,
 US (Residence), US (Nationality)

Patent and Priority Information (Country, Number, Date):

Patent: WO 200177945 A1 20011018 (WO 0177945)

Application: WO 2001US10722 20010402 (PCT/WO US0110722)

Priority Application: US 2000543049 20000405; US 2000203705 20000511; US
 2000216222 20000705; US 2001793687 20010226; US 2001817072 20010326

Designated States:

(Protection type is "patent" unless otherwise stated - for applications prior to 2004)

AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CR CU CZ DE DK DM DZ EE
 ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT
 LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM
 TR TT TZ UA UG US UZ VN YU ZA ZW

(EP) AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR

(OA) BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG

(AP) GH GM KE LS MW MZ SD SL SZ TZ UG ZW

(EA) AM AZ BY KG KZ MD RU TJ TM

Publication Language: English

Filing Language: English

Fulltext Word Count: 19312

Fulltext Availability:

Detailed Description

Claims

English Abstract

A **complaint** management system (10), also referred to as a **disputes** system, enables registered consumers (40) to file a **complaint** against a merchant (20). During **complaint** preparation, the **disputes** system advises the consumer (40) of relevant cases and other information, allows

19/AN,AZ,TI/1 (Item 1 from file: 348)
DIALOG(R)File 348:(c) 2005 European Patent Office. All rts. reserv.

01752676
Systems and methods for secure transaction management and electronic rights protection
Systeme und Verfahren zur gesicherten Transaktionsverwaltung und elektronischem Rechtsschutz
Systemes et procedes de gestion de transactions securisees et de protection de droits electroniques
APPLICATION (CC, No, Date): EP 2004075701 960213;
PRIORITY (CC, No, Date): US 388107 950213

19/AN,AZ,TI/2 (Item 2 from file: 348)
DIALOG(R)File 348:(c) 2005 European Patent Office. All rts. reserv.

01276898
CONTENTS MANAGEMENT SYSTEM, DEVICE, METHOD, AND PROGRAM STORAGE MEDIUM
INHALTSVERWALTUNGSSYSTEM, VORRICHTUNG, VERFAHREN UND PROGRAMMSPEICHERMEDIUM
SYSTEME, DISPOSITIF, PROCEDE ET SUPPORT DE PROGRAMME POUR LA GESTION DE CONTENUS
APPLICATION (CC, No, Date): EP 2000956997 000907; WO 2000JP6089 000907
PRIORITY (CC, No, Date): JP 99253660 990907; JP 99253661 990907; JP 99253662 990907; JP 99253663 990907; JP 99260638 990914; JP 99264082 990917; JP 99265866 990920

19/AN,AZ,TI/3 (Item 3 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

01066614
METHOD AND SYSTEM FOR MEDIA
PROCEDE ET SYSTEME POUR CONTENU MULTIMEDIA
Application: WO 2003US14878 20030510 (PCT/WO US03014878)

19/AN,AZ,TI/4 (Item 4 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

01008727
METHOD AND SYSTEM FOR MANAGING COMMITMENTS, REDUCING MEASUREMENT ERRORS, AND MAKING SAFE DISCLOSURES
PROCEDE ET SYSTEME DE GESTION DES ENGAGEMENTS, DE REDUCTION DES ERREURS DE MESURE ET DE PRESENTATIONS SURES
Application: WO 2002US35204 20021101 (PCT/WO US0235204)
Parent Application/Grant:
Related by Continuation to: US 20011475 20011101 (CIP)

19/AN,AZ,TI/5 (Item 5 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

01008578
SYSTEM AND METHOD FOR ESTABLISHING OR MODIFYING AN ACCOUNT WITH USER SELECTABLE TERMS
SYSTEME ET PROCEDE POUR ETABLIR OU MODIFIER UN COMPTE AVEC DES TERMES

SELECTIONNABLES PAR L'UTILISATEUR

Application: WO 2002US34870 20021031 (PCT/WO US02034870)

19/AN,AZ,TI/6 (Item 6 from file: 349)

DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00963611

**EXTENDED WEB ENABLED MULTI-FEATURED BUSINESS TO BUSINESS COMPUTER SYSTEM
FOR RENTAL VEHICLE SERVICES
SYSTEME INFORMATIQUE INTERENTREPRISES A ELEMENTS MULTIPLES A ACCES INTERNET
POUR SERVICES DE LOCATION DE VEHICULES**

Application: WO 2001US51431 20011019 (PCT/WO US0151431)

Parent Application/Grant:

Related by Continuation to: US 2000694050 20001020 (CIP)

19/AN,AZ,TI/7 (Item 7 from file: 349)

DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00844335

**AUTOMATED COMPLAINT MANAGEMENT SYSTEM
SYSTEME AUTOMATISE DE GESTION DE PLAINTES**

Application: WO 2001US10722 20010402 (PCT/WO US0110722)

19/AN,AZ,TI/8 (Item 8 from file: 349)

DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00836144

**NETWORKED INTERACTIVE TOY SYSTEM
SYSTEME DE JOUETS INTERACTIFS EN RESEAU**

Application: WO 2001IL248 20010314 (PCT/WO IL0100248)

19/AN,AZ,TI/9 (Item 9 from file: 349)

DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00806384

**NETWORK AND LIFE CYCLE ASSET MANAGEMENT IN AN E-COMMERCE ENVIRONMENT AND
METHOD THEREOF**

**GESTION D'ACTIFS DURANT LE CYCLE DE VIE ET EN RESEAU DANS UN ENVIRONNEMENT
DE COMMERCE ELECTRONIQUE ET PROCEDE ASSOCIE**

Application: WO 2000US32324 20001122 (PCT/WO US0032324)

19/AN,AZ,TI/10 (Item 10 from file: 349)

DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00806383

**COLLABORATIVE CAPACITY PLANNING AND REVERSE INVENTORY MANAGEMENT DURING
DEMAND AND SUPPLY PLANNING IN A NETWORK-BASED SUPPLY CHAIN ENVIRONMENT
AND METHOD THEREOF**

**PLANIFICATION EN COLLABORATION DES CAPACITES ET GESTION ANTICIPEE DES
STOCKS LORS DE LA PLANIFICATION DE L'OFFRE ET DE LA DEMANDE DANS UN
ENVIRONNEMENT DE CHAINE D'APPROVISIONNEMENT FONDEE SUR LE RESEAU ET
PROCEDE ASSOCIE**

Application: WO 2000US32309 20001122 (PCT/WO US0032309)

19/AN,AZ,TI/11 (Item 11 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00806382

METHOD FOR AFFORDING A MARKET SPACE INTERFACE BETWEEN A PLURALITY OF
MANUFACTURERS AND SERVICE PROVIDERS AND INSTALLATION MANAGEMENT VIA A
MARKET SPACE INTERFACE

PROCEDE DE MISE A DISPOSITION D'UNE INTERFACE D'ESPACE DE MARCHÉ ENTRE UNE
PLURALITE DE FABRICANTS ET DES FOURNISSEURS DE SERVICES ET GESTION
D'UNE INSTALLATION VIA UNE INTERFACE D'ESPACE DE MARCHÉ

Application: WO 2000US32308 20001122 (PCT/WO US0032308)

19/AN,AZ,TI/12 (Item 12 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00802534

ANY-TO-ANY COMPONENT COMPUTING SYSTEM

SYSTEME INFORMATIQUE A COMPOSANTS TOUTE CATEGORIE

Application: WO 2000US31231 20001113 (PCT/WO US0031231)

19/AN,AZ,TI/13 (Item 13 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00761431

A SYSTEM, METHOD, AND ARTICLE OF MANUFACTURE FOR PROVIDING COMMERCE-RELATED
WEB APPLICATION SERVICES

SYSTEME, PROCEDE ET ARTICLE MANUFACTURE DESTINES A LA FOURNITURE DE
SERVICES D'APPLICATION DANS LE WEB LIES AU COMMERCE

Application: WO 2000US14420 20000525 (PCT/WO US0014420)

19/AN,AZ,TI/14 (Item 14 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00761429

METHODS, CONCEPTS AND TECHNOLOGY FOR A VIRTUAL SHOPPING SYSTEM CAPABLE OF
ASSESSING NEEDS OF A CUSTOMER AND RECOMMENDING A PRODUCT OR SERVICE
BASED ON SUCH ASSESSED NEEDS

PROCEDES, CONCEPTS ET TECHNOLOGIE POUR SYSTEME D'ACHAT VIRTUEL CAPABLE
D'EVALUER LES BESOINS D'UN CLIENT ET DE RECOMMANDER UN PRODUIT OU UN
SERVICE SUR LA BASE DE CES BESOINS

Application: WO 2000US14357 20000524 (PCT/WO US0014357)

19/AN,AZ,TI/15 (Item 15 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00761424

A SYSTEM, METHOD, AND ARTICLE OF MANUFACTURE FOR PHASE DELIVERY OF
COMPONENTS OF A SYSTEM REQUIRED FOR IMPLEMENTATION OF TECHNOLOGY

SYSTEME, PROCEDE ET ARTICLE MANUFACTURE DESTINES A LA FOURNITURE PAR PHASES
DE COMPOSANTS D'UN SYSTEME NECESSAIRES A L'APPLICATION D'UNE TECHNIQUE

Application: WO 2000US14458 20000524 (PCT/WO US0014458)

19/AN,AZ,TI/16 (Item 16 from file: 349)
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00432616

A COMMUNICATION SYSTEM ARCHITECTURE
SYSTEME, PROCEDE ET PRODUIT MANUFACTURE POUR L'ARCHITECTURE D'UN SYSTEME DE
COMMUNICATION

Application: WO 97US21174 19971114 (PCT/WO US9721174)

19/AN,AZ,TI/17 (Item 17 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00363084

METHOD AND SYSTEM FOR PROVIDING CREDIT SUPPORT TO PARTIES ASSOCIATED WITH
DERIVATIVE AND OTHER FINANCIAL TRANSACTIONS
PROCEDE VISANT A FOURNIR UN SOUTIEN AU CREDIT A DES PARTIES ASSOCIEES ET
AUTRES TRANSACTIONS FINANCIERES ET DISPOSITIF CORRESPONDANT

Application: WO 96GB1687 19960715 (PCT/WO GB9601687)

19/AN,AZ,TI/18 (Item 18 from file: 349)
DIALOG(R)File 349:(c) 2005 WIPO/Univentio. All rts. reserv.

00344642

SYSTEMS AND METHODS FOR SECURE TRANSACTION MANAGEMENT AND ELECTRONIC RIGHTS
PROTECTION
SYSTEMES ET PROCEDES DE GESTION SECURISEE DE TRANSACTIONS ET DE PROTECTION
ELECTRONIQUE DES DROITS

Application: WO 96US2303 19960213 (PCT/WO US9602303)

? show files;ds
 File 2:INSPEC 1969-2005/Mar W2
 (c) 2005 Institution of Electrical Engineers
 File 35:Dissertation Abs Online 1861-2005/Feb
 (c) 2005 ProQuest Info&Learning
 File 65:Inside Conferences 1993-2005/Mar W3
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 File 99:Wilson Appl. Sci & Tech Abs 1983-2005/Feb
 (c) 2005 The HW Wilson Co.
 File 474:New York Times Abs 1969-2005/Mar 19
 (c) 2005 The New York Times
 File 475:Wall Street Journal Abs 1973-2005/Mar 18
 (c) 2005 The New York Times
 File 583:Gale Group Globalbase(TM) 1986-2002/Dec 13
 (c) 2002 The Gale Group
 File 139:EconLit 1969-2005/Mar
 (c) 2005 American Economic Association
 File 111:TGG Natl.Newspaper Index(SM) 1979-2005/Mar 18
 (c) 2005 The Gale Group

*bibliographic
NPL files*

Set	Items	Description
S1	1280324	CHARGE OR CREDIT OR BANK OR MASTER OR STORE OR SHOP OR MER- CHANT
S2	2437972	CARD OR ACCOUNT OR LINE OR CONTRACT? ? OR AGREEMENT
S3	26396	CHARGE CARD? ? OR CREDIT CARD? ? OR BANK CARD? ? OR VISA OR M- ASTER CARD OR AMERICAN() EXPRESS OR CHARGE ACCOUNT? ? OR CREDIT L- INE? ?
S4	183856	UNHAPPY OR UNSATISF? OR DISSATISFIED OR DISPUT??? OR COMPL- AIN??? OR ("NOT" OR NON OR UN)() (HAPPY OR SATISFIED OR CONTEN- T?? OR PLEASED) OR DISCONTENT?? OR DISPLEASED
S5	1473821	NEGO?IATI??? OR BARGAINING OR PARLEY??? OR HAGGL??? OR DIC- KER??? OR MODIFY??? OR MODIFI? OR ALTERNATIVE OR FLEXIBLE OR - CUSTOM OR CUSTOMI? OR MODIF? OR ADAPT? OR PERSONALI? OR INDIV- IDUALI? OR TAILOR???
S6	4148659	TERM? ? OR PARAMET? OR INTEREST() RATE OR (MONTHLY OR MINIM- UM)() PAYMENT OR TIME OR PERIOD OR CREDIT() LIMIT OR GRACE OR A- MNESTY OR LATE() FEE OR TIMESPAN? ? OR DURATION?
S7	71195	S3 OR (S1(2N)S2)
S8	407	S4(S) (S5(10N)S6)
S9	0	S7(S)S8
S10	1	S7 AND S8
S11	105367	S5(10N)S6
S12	99	S7(S)S11
S13	2	S4 AND S12
S14	62	S12 NOT PY>1997
S15	58	S14 NOT PD=19970313:20050430
S16	58	RD (unique items)
S17	61	S7(20N)S11
S18	53	S7(15N)S11
S19	54	S13 OR S18
S20	34	S19 NOT PY>1997
S21	32	S20 NOT PD=19970313:20050430
S22	32	RD (unique items)

22/3,K/16 (Item 3 from file: 475)
DIALOG(R)File 475:Wall Street Journal Abs
(c) 2005 The New York Times. All rts. reserv.

05507290

1989

Wall Street Journal, Col. 3, Pg. 5, Sec. 2
Thursday December 14 1989

ABSTRACT:

...reports loss for third-consecutive quarter and says it will be in default of its **bank** -loan **agreement** for fiscal year ending Jan 1990 unless it can find **alternative** financing or renegotiate **terms** of loan; for third quarter ended Oct 28, it had \$2.2 million loss compared...

22/3,K/17 (Item 4 from file: 475)
DIALOG(R)File 475:Wall Street Journal Abs
(c) 2005 The New York Times. All rts. reserv.

04765055

BUSINESS BRIEFS

Wall Street Journal, Col. 3, Pg. 47, Sec. 1
Tuesday January 28 1986

ABSTRACT:

Western Union Corporation says it hopes to complete **negotiations** for a new long- **term** **credit** **agreement** by end of first quarter (S)

22/3,K/27 (Item 5 from file: 583)
DIALOG(R)File 583:Gale Group Globalbase(TM)
(c) 2002 The Gale Group. All rts. reserv.

03582569

SMART CARD APPLICATIONS REVIEWED

UK - SMART CARD APPLICATIONS REVIEWED
Computing (CNG) 5 July 1990 p18-19

... magnetic stripe cards as they contain microprocessors and memory chips. The cards can also be **modified** each **time** they are used. Smart cards are hoped to combat increasing **credit** **card** fraud, but the technology is slow to expand as installing the necessary equipment in shops...

22/3,K/32 (Item 2 from file: 111)
DIALOG(R)File 111:TGG Natl.Newspaper Index(SM)
(c) 2005 The Gale Group. All rts. reserv.

02014028 Supplier Number: 04111020

Western Union Corp. (**Business Briefs** - negotiating **long- term** **credit** agreement)

Wall Street Journal , Tue ed, col 3, p47(E)
Jan 28, 1986

LANGUAGE: English RECORD TYPE: Citation COLUMN LENGTH: 2 col in

Western Union Corp. (**Business Briefs** - negotiating **long- term** **credit** agreement)

22/AA,AN,TI/1 (Item 1 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

Title: A study of the phonon frequencies of narrow gap semiconducting
mixed crystal Pb/sub 0.8/Sn/sub 0.2/Se

22/AA,AN,TI/2 (Item 2 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

Title: Binding energies and spectroscopic constants of the first-row and
second-row diatomic hydrides

22/AA,AN,TI/3 (Item 3 from file: 2)
DIALOG(R)File 2:(c) 2005 Institution of Electrical Engineers. All rts.
reserv.

Title: DBC-a database computer for very large databases

22/AA,AN,TI/4 (Item 1 from file: 35)
DIALOG(R)File 35:(c) 2005 ProQuest Info&Learning. All rts. reserv.

01588568
MEMORY FOR RECENT WORDS: A MATTER OF SHORT-TERM MEMORY STORAGE OR LONG-TERM
DISTINCTIVENESS

22/AA,AN,TI/5 (Item 2 from file: 35)
DIALOG(R)File 35:(c) 2005 ProQuest Info&Learning. All rts. reserv.

1082540
THE IMPACT OF ALTERNATIVE PRESENTATIONS OF CASH FLOWS FROM OPERATIONS ON
THE RELEVANCE OF FUNDS FLOW INFORMATION

22/AA,AN,TI/6 (Item 3 from file: 35)
DIALOG(R)File 35:(c) 2005 ProQuest Info&Learning. All rts. reserv.

848903
THE MID-TERM BARGAINING OBLIGATION IN THE FEDERAL SECTOR

22/AA,AN,TI/7 (Item 1 from file: 474)
DIALOG(R)File 474:(c) 2005 The New York Times. All rts. reserv.

01186363 NYT Sequence Number: 072044821027
(Top executives at American Express Co and Olympia & York are still
negotiating terms of lease whereby American Express would occupy
one of four towers at Battery Park City, the 6 million square ft
commercial complex that Olympia is developing at Battery Park (NYC) (S).)

22/AA,AN,TI/8 (Item 2 from file: 474)
DIALOG(R)File 474:(c) 2005 The New York Times. All rts. reserv.

00874415 NYT Sequence Number: 060167780301

(Beker Industries chmn Erol Beker resumes former position as chief exec. Will serve in post until co pres A P Gates recovers from recent illness. Beker notes firm is negotiating amendments of term -loan and revolving- credit agreement with eight lending banks to resolve current defaults in company's financial requirements (S).)

22/AA,AN,TI/9 (Item 3 from file: 474)

DIALOG(R)File 474:(c) 2005 The New York Times. All rts. reserv.

00730100 NYT Sequence Number: 090936761019

(1st Va Mortgage & Real Estate Investment Trust says it was in default under terms of \$52.4-million credit agreement that matured Oct 15. Is negotiating with lending banks's reprs for new 3-yr term loan agreement (S).)

22/AA,AN,TI/10 (Item 4 from file: 474)

DIALOG(R)File 474:(c) 2005 The New York Times. All rts. reserv.

00479878 NYT Sequence Number: 046908740705

(Grumman Corp is optimistic Fed Govt will supply \$200-million in low-interest loans for production of F-14 fighters for USN and for Iran. Is negotiating with consortium of commercial banks to resume co's short- term line of credit , terminated 2 yrs ago because of financial problems incurred during production of craft. Loans will be almost twice figure mentioned by Vice Adm Kent L Lee during testimony before HR Armed Services Com, which Grumman officials attribute to financial requirements of production of craft for Iran and USN. Iran has ordered 80 F-14 jets. Cost of these planes will ultimately be borne by Iranian Govt but all contracts for such items are made through Defense Dept. Iranian Embassy spokesman Assad Homayoun says he does not know how payments will be arranged (M).)

22/AA,AN,TI/11 (Item 5 from file: 474)

DIALOG(R)File 474:(c) 2005 The New York Times. All rts. reserv.

00412456 NYT Sequence Number: 067796730426

(United Rubber Workers and Goodyear Tire & Rubber Co reach agreement on Apr 25 on new contract calling for wage increases totaling about 16% over 3 yrs; new pact is expected to set wage pattern for rest of rubber indus, which is still in negotiations with union; accord marks first time in more than decade that master contract has been signed in rubber indus without strike; union members still must ratify pact, but neither co nor union expect problems; FMCS dir W J Usery Jr hails agreement as 'most encouraging,' coming as it does in indus in which prior contract negotiations have been marked by frequent strikes; says agreement is another in recent series of developments in which labor and mgt strongly indicate they are striving to reach new era of statesmanship and understanding; AFL-CIO spokesman asserts that rubber settlement is indication that G Meany was right in noting that wages are not what is causing inflation; terms of contract detailed)

22/AA,AN,TI/12 (Item 6 from file: 474)
DIALOG(R)File 474:(c) 2005 The New York Times. All rts. reserv.

00226859 NYT Sequence Number: 080602711126
(Brit Foreign Sec Home outlines terms of proposed settlement with Rhodesia, Commons; defends terms as 'fair and honorable' and only realistic alternative to outright apartheid; Labor MPs, led by D Healey, charge agreement makes no provision for firm time-scale for progress toward majority rule, for outside guarantees against broken pledges and for outright repeal of Land Tenure Act; Home announces apptmt of Lord Pearce as head of Brit comm that will survey Rhodesian opinion on agreement)

22/AA,AN,TI/13 (Item 7 from file: 474)
DIALOG(R)File 474:(c) 2005 The New York Times. All rts. reserv.

00077675 NYT Sequence Number: 003270700915
(Popular Front says US hostages are being treated on same basis as Israelis and will be released with Israelis; announcement comes after day-long stream of threats and counterthreats from several sides, differences among commandos and release of Dutch TWA purser through informal mediation conducted by Brit Arabist M Adams; US State Dept says 3 of 37 or 38 US hostages might be considered Israeli citizens but guerrillas reptonly consider US hostage with Israeli visa stamp as Israeli; negotiations seen at impasse; IRC and Papal delegations marking time while waiting to see prisoners; guerrillas express willingness to talk separately with GB, W Ger and Switzerland; reptonly bar further talks because their position is known; Popular Front central com meets and its members reptonly differ regarding treatment of hostages and terms for their release; differences seen broadening split between Popular Front and Central Com; Popular Front repr Bassam announces decision to bar outsiders from visiting hostages; says they are well treated and housed in and around Amman; inclusion among hostages of US Vietnam veteran K Hubler who suffered minor breakdown noted; most Palestinians seen angry with Israeli arrests; Palestine Red Crescent exec G Saudi charges number arrested is over 450)

22/AA,AN,TI/14 (Item 1 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

06778257
CHRYSLER CORP

22/AA,AN,TI/15 (Item 2 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

05519466
ENVIRONMENTAL SYSTEMS CO MISSES PAYMENT ON DEBT

22/AA,AN,TI/16 (Item 3 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

05507290

1989

22/AA,AN,TI/17 (Item 4 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

04765055
BUSINESS BRIEFS

22/AA,AN,TI/18 (Item 5 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

01091501 NYT Sequence Number: 010218770131
(Gladding Corp announces that losses on liquidation of several hundred thousand 23-channel citizens band radios plus other problems may have wiped out entire \$5.4 Million profit posted by co during 1st 9 months of fiscal yr ended Sept 30 '76. Uncertainty over losses has caused co to delay earnings figures and annual rept for fiscal yr. Value of 23-channel radios became hard to determine when Govt announced in July '76 that Class D CB radios could increase their coverage to 40 channels from 23 channels. Co plans to negotiate with its banks and institutional lenders for necessary modifications of existing terms of its revolving credit agreement . Expects to release earnings rept in late Feb '77 (S).)

22/AA,AN,TI/19 (Item 6 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

01086659 NYT Sequence Number: 005376770427
(Tierco, real estate business trust, repts net loss of \$117,667 for fiscal '77 first qr compared with net loss of \$109,055 yr before. Says it will be unable to make \$1 million debt reduction required in May under terms of its revolving credit agreement . Notes negotiations continue toward change in its debt amortization requirements and asset-note payable swap program (S).)

22/AA,AN,TI/20 (Item 7 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

01081126 NYT Sequence Number: 019780760402
(HNC Mortgage & Realty Investors receives extension until may 15 '76 on bank - credit line of \$87.7 Million to allow further time for negotiation of new agreement (M).)

22/AA,AN,TI/21 (Item 8 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

01069630 NYT Sequence Number: 008284760323
(Cameron Brown Investment Group repts \$14 million loss '75 compared with \$3.8 Million loss in '74. Notes it is in default on certain terms of its bank credit agreement . Seeks modification of terms and

implementation of asset-exchange program through which trust may be able to swap assets for debt cancellations. Plans to seek shareholder approval to stop operating as real estate investment trust (S).)

22/AA,AN,TI/22 (Item 9 from file: 475)
DIALOG(R)File 475:(c) 2005 The New York Times. All rts. reserv.

01039422 NYT Sequence Number: 001010751219
(LMI Investors is in default on bank - credit agreement ; is negotiating revision of terms with 15 lending banks and has reached preliminary agreement to lower interest rate to 6% from 130% of prime rate (S))

22/AA,AN,TI/23 (Item 1 from file: 583)
DIALOG(R)File 583:(c) 2002 The Gale Group. All rts. reserv.

06152426
Commerzbank mit hohem Kartenanteil
GERMANY: COMMERZBANK'S MARKETING SUCCESSFUL

22/AA,AN,TI/24 (Item 2 from file: 583)
DIALOG(R)File 583:(c) 2002 The Gale Group. All rts. reserv.

06056096
Celcom to launch digital network next year
MALAYSIA: CELCOM TO LAUNCH DIGITAL NETWORK

22/AA,AN,TI/25 (Item 3 from file: 583)
DIALOG(R)File 583:(c) 2002 The Gale Group. All rts. reserv.

05944407
Mineralbank Sells American Express Travelers Cheques
BULGARIA: MINERALBANK EXPANDS SERVICE

22/AA,AN,TI/26 (Item 4 from file: 583)
DIALOG(R)File 583:(c) 2002 The Gale Group. All rts. reserv.

04564515
xxx
US - MAXTOR AGREES TERMS ON BORROWINGS

22/AA,AN,TI/27 (Item 5 from file: 583)
DIALOG(R)File 583:(c) 2002 The Gale Group. All rts. reserv.

03582569
SMART CARD APPLICATIONS REVIEWED
UK - SMART CARD APPLICATIONS REVIEWED

22/AA,AN,TI/28 (Item 6 from file: 583)
DIALOG(R)File 583:(c) 2002 The Gale Group. All rts. reserv.

02954154
SIX SPONSORS LINE UP FOR '92 GAMES
US - SIX SPONSORS LINE UP FOR '92 GAMES

22/AA,AN,TI/29 (Item 7 from file: 583)
DIALOG(R)File 583:(c) 2002 The Gale Group. All rts. reserv.

01022265
LARGER CREDIT CARDS ABSORB SMALLER ONES
DENMARK - LARGER CREDIT CARDS ABSORB SMALLER ONES

22/AA,AN,TI/30 (Item 1 from file: 139)
DIALOG(R)File 139:(c) 2005 American Economic Association. All rts. reserv.

289565
TITLE: Credit Markets and Economic Change in Southeastern France 1630-1788
AUTHOR(S) AFFILIATION: UCLA

22/AA,AN,TI/31 (Item 1 from file: 111)
DIALOG(R)File 111:(c) 2005 The Gale Group. All rts. reserv.

04585452 Supplier Number: 17302724
LIBERTY PROPERTY TRUST ANNOUNCES MODIFICATIONS TO LINE OF CREDIT ,
LONG- TERM FINANCING, DIVIDEND

22/AA,AN,TI/32 (Item 2 from file: 111)
DIALOG(R)File 111:(c) 2005 The Gale Group. All rts. reserv.

02014028 Supplier Number: 04111020
Western Union Corp. (Business Briefs - negotiating long- term credit
agreement)

? show files;ds
 File 9:Business & Industry(R) Jul/1994-2005/Mar 18
 (c) 2005 The Gale Group
 File 15:ABI/Inform(R) 1971-2005/Mar 21
 (c) 2005 ProQuest Info&Learning
 File 16:Gale Group PROMT(R) 1990-2005/Mar 21
 (c) 2005 The Gale Group
 File 20:Dialog Global Reporter 1997-2005/Mar 21
 (c) 2005 The Dialog Corp.
 File 148:Gale Group Trade & Industry DB 1976-2005/Mar 21
 (c)2005 The Gale Group
 File 160:Gale Group PROMT(R) 1972-1989
 (c) 1999 The Gale Group
 File 275:Gale Group Computer DB(TM) 1983-2005/Mar 21
 (c) 2005 The Gale Group

*full text NR
files-1*

Set	Items	Description
S1	13718251	CHARGE OR CREDIT OR BANK OR MASTER OR STORE OR SHOP OR MER- CHANT
S2	17663565	CARD OR ACCOUNT OR LINE OR CONTRACT? ? OR AGREEMENT
S3	430638	CHARGECARD? ? OR CREDITCARD? ? OR BANKCARD? ? OR VISA OR M- ASTERCARD OR AMERICAN()EXPRESS OR CHARGEACCOUNT? ? OR CREDITL- INE? ?
S4	2844923	UNHAPPY OR UNSATISF? OR DISSATISFIED OR DISPUT??? OR COMPL- AIN??? OR ("NOT" OR NON OR UN)() (HAPPY OR SATISFIED OR CONTEN- T?? OR PLEASED) OR DISCONTENT?? OR DISPLEASED
S5	7529182	NEGO?IATI??? OR BARGAINING OR PARLEY??? OR HAGGL??? OR DIC- KER??? OR MODIFY??? OR MODIFI? OR ALTERNATIVE OR FLEXIBLE OR - CUSTOM OR CUSTOMI? OR MODIF? OR ADAPT? OR PERSONALI? OR INDIV- IDUALI? OR TAILOR???
S6	1196401	S3 OR (S1(2N)S2)
S7	118847	S4(S)S5
S8	407698	S4(S)(TERM? ? OR PARAMET? OR INTEREST()RATE OR (MONTHLY OR MINIMUM)()PAYMENT OR TIME OR PERIOD OR CREDIT()LIMIT OR GRACE OR AMNESTY OR LATE()FEE OR TIMESPAN? ? OR DURATION?)
S9	27775	S7(10N)S8
S10	711	S6(S)S9
S11	1908	S4(10N)(S5(7N)(TERM? ? OR PARAMET? OR INTEREST()RATE OR (M- ONTHLY OR MINIMUM)()PAYMENT OR TIME OR PERIOD OR CREDIT()LIMIT OR GRACE OR AMNESTY OR LATE()FEE OR TIMESPAN? ? OR DURATION?-))
S12	9	S6(S)S11
S13	94	S6 AND S11
S14	28	S6(4S)S11
S15	32	S6(6S)S11
S16	10	S15 NOT PY>1997
S17	33	S13 NOT PY>1997
S18	32	S17 NOT PD=19970313:20050430
S19	29	RD (unique items)

19/3,K/5 (Item 4 from file: 15)
DIALOG(R)File 15:ABI/Inform(R)
(c) 2005 ProQuest Info&Learning. All rts. reserv.

01098975 97-48369

How to be a one-to-one marketer

Anonymous

Inc. v17n14 PP: 58 Oct 1995
ISSN: 0162-8968 JRNL CODE: INO
WORD COUNT: 431

...TEXT: all options for collecting names: sales transactions, contests, sponsored events, frequent-buyer programs 800 numbers, **credit - card** records, simple survey records, and quick one-question polls when customers call.

Link customers' identities to their transactions. **Credit - card** records are especially useful but not necessary. The best way to build individual customer transaction...

...questions can be tailored to a customer's wish list, business issues, and so on. **Customizing** what you say to customers takes **time**, not money.

Treat **complaints** as opportunities for additional business. Call back complaining customers; don't make them chase you...

19/3,K/12 (Item 11 from file: 15)
DIALOG(R)File 15:ABI/Inform(R)
(c) 2005 ProQuest Info&Learning. All rts. reserv.

00635002 92-49942

Claimsmanship - A Current Discussion

Zack, James G., Jr.

American Association of Cost Engineers Transactions v1 PP: D.6.1-D.6.9
1992

ISSN: 0065-7158 JRNL CODE: AEE
WORD COUNT: 6496

...TEXT: items not included in the escrowed documents shall not be admitted as evidence in any **negotiation** or legal proceeding at a later **time**, should a **dispute** arise (11,12). If appropriate safeguards are structured such that proprietary material can be protected...

...owners contemplating exactly this situation have drafted a specification which allows both parties to track, **account** for, and **bank** that float which is created solely by their activities (ie, an owner returning a critical...

19/3,K/19 (Item 3 from file: 148)
DIALOG(R)File 148:Gale Group Trade & Industry DB
(c)2005 The Gale Group. All rts. reserv.

08207961 SUPPLIER NUMBER: 17508097 (USE FORMAT 7 OR 9 FOR FULL TEXT)
The road to one-to-one marketing.(includes related article on book 'The One to One Future: Building Relationships One Customer at a Time')(Cover Story)

Greco, Susan

Inc., v17, n14, p56(7)

Oct, 1995

DOCUMENT TYPE: Cover Story ISSN: 0162-8968 LANGUAGE: English

RECORD TYPE: Fulltext; Abstract

WORD COUNT: 5079 LINE COUNT: 00413

... all options for collecting names: sales transactions, contests, sponsored events, frequent-buyer programs, 800 numbers, **credit - card** records, simple survey cards, and quick one-question polls when customers call.

Link customers' identities to their transactions. **Credit - card** records are especially useful but not necessary. The best way to build individual customer transaction...

...questions can be tailored to a customer's wish list, business issues, and so on. **Customizing** what you say to customers takes **time**, not money. money.

Treat **complaints** as opportunities for additional business. Call back complaining customers; don't make them chase you...

19/3,K/21 (Item 5 from file: 148)

DIALOG(R)File 148:Gale Group Trade & Industry DB

(c)2005 The Gale Group. All rts. reserv.

07574842 SUPPLIER NUMBER: 15908535 (USE FORMAT 7 OR 9 FOR FULL TEXT)

Key Federal lowers deposit on secured card. (Key Federal Savings Bank)

(Brief Article)

Fickenscher, Lisa

American Banker, v159, n216, p19(1)

Nov 8, 1994

DOCUMENT TYPE: Brief Article ISSN: 0002-7561 LANGUAGE: ENGLISH

RECORD TYPE: FULLTEXT

WORD COUNT: 315 LINE COUNT: 00023

... the Havre de Grace Md.-based thrift is lowering the deposit amount that secures the **line** of **credit**. When customers send in their deposit check with their application, they can save \$100 on the price of the deposit, and they receive a 25% increase on their **credit line**.

Key Federal normally requires \$400 as a deposit, which earns a **credit line** of \$500, or 125% of \$400. "If we get a deposit with an application, then...

...Council of Better Business Bureaus, which stipulates that Key Federal participate in the council's **alternative dispute** resolution program; a lowered **interest rate**; and a number of educational tools designed to help consumers understand secured cards.

Key Federal...

19/3,K/25 (Item 9 from file: 148)

DIALOG(R)File 148:Gale Group Trade & Industry DB

(c)2005 The Gale Group. All rts. reserv.

02168982 SUPPLIER NUMBER: 03413616 (USE FORMAT 7 OR 9 FOR FULL TEXT)

A plague of lawyers: with crowded courts and seven-digit legal bills, companies are finding new ways to settle differences.

Johnson, Sharon

Working Woman, v9, p180(4)

Sept, 1984

CODEN: WOWOD

ISSN: 0145-5761

LANGUAGE: ENGLISH

RECORD TYPE:

FULLTEXT

WORD COUNT: 2899

LINE COUNT: 00229

... ways to settle their problems without going to court. More and more are turning to **alternative dispute** resolution --a **term** that covers everything from traditional arbitration to new experiments, such as mini-trials and hiring...battling over whether the Cleveland-based conglomerate had infringed on a Telecredit patent for computerized **credit** - **card** and check-authorization machines. A trial date had not been set, and TRW stood to...

19/AA,AN,TI/1 (Item 1 from file: 9)
DIALOG(R)File 9:(c) 2005 The Gale Group. All rts. reserv.

1244765 Supplier Number: 01244765
TICKETMASTER RIVALS SEEK NEW BIZ

19/AA,AN,TI/2 (Item 1 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

02543698 191010381
The Commission on Industrial Relations in Britain 1969-74: A retrospective
and prospective evaluation

19/AA,AN,TI/3 (Item 2 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

01375370 00-26357
The road from here: U.S. trade policy in the second Clinton administration

19/AA,AN,TI/4 (Item 3 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

01112652 97-62046
Business incentives and the GATT subsidies agreement

19/AA,AN,TI/5 (Item 4 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

01098975 97-48369
How to be a one-to-one marketer

19/AA,AN,TI/6 (Item 5 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

01096646 97-46040
How to rescue your diversity program

19/AA,AN,TI/7 (Item 6 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

01033067 96-82460
Third-party roles in conflict management

19/AA,AN,TI/8 (Item 7 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00951831 96-01224
New York modernizes its Statute of Frauds

19/AA,AN,TI/9 (Item 8 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00903344 95-52736

Learn from yesterday, prepare for tomorrow: Bankruptcy and commercial collections in the 21st century

19/AA,AN,TI/10 (Item 9 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00653047 93-02268

The Permissible Uses of Forced Union Dues from Hanson to Beck

19/AA,AN,TI/11 (Item 10 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00635005 92-49945

Dispute Resolution: Managing Construction Conflict with Step Negotiations

19/AA,AN,TI/12 (Item 11 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00635002 92-49942

Claimsanship - A Current Discussion

19/AA,AN,TI/13 (Item 12 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00598405 92-13578

Collective Bargaining, 1991: Recession Colors Talks

19/AA,AN,TI/14 (Item 13 from file: 15)
DIALOG(R)File 15:(c) 2005 ProQuest Info&Learning. All rts. reserv.

00565017 91-39371

The Dark Side of a Trip to the Track

19/AA,AN,TI/15 (Item 1 from file: 16)
DIALOG(R)File 16:(c) 2005 The Gale Group. All rts. reserv.

04094346 Supplier Number: 45966563
Time Off ups choice of cities with Eurostar

19/AA,AN,TI/16 (Item 2 from file: 16)
DIALOG(R)File 16:(c) 2005 The Gale Group. All rts. reserv.

02387619 Supplier Number: 43138195
Wells Fargo to use mandatory arbitration

19/AA,AN,TI/17 (Item 1 from file: 148)

DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

09293149 SUPPLIER NUMBER: 19033711

**Time limits under Rule 10304 of the NASD Code of Arbitration Procedure:
making arbitrators more like judges or judges more like arbitrators?
(National Association of Securities Dealers)**

19/AA,AN,TI/18 (Item 2 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

08732586 SUPPLIER NUMBER: 18348263

**Overcoming the pathology of litigation: an ADR primer for
executives.(alternate dispute resolution)**

19/AA,AN,TI/19 (Item 3 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

08207961 SUPPLIER NUMBER: 17508097

**The road to one-to-one marketing.(includes related article on book 'The One
to One Future: Building Relationships One Customer at a Time')(Cover
Story)**

19/AA,AN,TI/20 (Item 4 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

08101702 SUPPLIER NUMBER: 17294067

Ticketmaster rivals seek new biz.

19/AA,AN,TI/21 (Item 5 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

07574842 SUPPLIER NUMBER: 15908535

**Key Federal lowers deposit on secured card. (Key Federal Savings Bank)
(Brief Article)**

19/AA,AN,TI/22 (Item 6 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

06745869 SUPPLIER NUMBER: 14555479

The economics of natural gas in Mexico: revisited.

19/AA,AN,TI/23 (Item 7 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

04625517 SUPPLIER NUMBER: 08853954

**Dealers and dealing in a periodic market: informal retailing in
ethnographic perspective.**

19/AA,AN,TI/24 (Item 8 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

03698592 SUPPLIER NUMBER: 06710058
The football strike of 1987: a question of free agency.

19/AA,AN,TI/25 (Item 9 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

02168982 SUPPLIER NUMBER: 03413616
A plague of lawyers: with crowded courts and seven-digit legal bills,
companies are finding new ways to settle differences.

19/AA,AN,TI/26 (Item 10 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

02038865 SUPPLIER NUMBER: 03119169
New ways to cut legal costs.

19/AA,AN,TI/27 (Item 11 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

01765230 SUPPLIER NUMBER: 02815881
USW, steel mills dispute on \$1.25 wage cut issue to arbitrator on July 27.

19/AA,AN,TI/28 (Item 12 from file: 148)
DIALOG(R)File 148:(c)2005 The Gale Group. All rts. reserv.

01753353 SUPPLIER NUMBER: 02592003
Less costly steel pact predicted; USW, big mills seen in late Feb. accord.

19/AA,AN,TI/29 (Item 1 from file: 275)
DIALOG(R)File 275:(c) 2005 The Gale Group. All rts. reserv.

02035353 SUPPLIER NUMBER: 19088899
First NC built for the desktop. (Sun Microsystems' JavaStation 1 network
computer)(Includes related articles on HotJava Views Webtop and
applications for the JavaStation) (Hardware Review)(Evaluation)

? show file;ds
 File 476:Financial Times Fulltext 1982-2005/Mar 21
 (c) 2005 Financial Times Ltd
 File 610:Business Wire 1999-2005/Mar 21
 (c) 2005 Business Wire.
 File 613:PR Newswire 1999-2005/Mar 21
 (c) 2005 PR Newswire Association Inc
 File 621:Gale Group New Prod.Annou.(R) 1985-2005/Mar 21
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 File 624:McGraw-Hill Publications 1985-2005/Mar 21
 (c) 2005 McGraw-Hill Co. Inc
 File 634:San Jose Mercury Jun 1985-2005/Mar 18
 (c) 2005 San Jose Mercury News
 File 636:Gale Group Newsletter DB(TM) 1987-2005/Mar 21
 (c) 2005 The Gale Group
 File 810:Business Wire 1986-1999/Feb 28
 (c) 1999 Business Wire
 File 813:PR Newswire 1987-1999/Apr 30
 (c) 1999 PR Newswire Association Inc

*full text NPL
files-2*

Set	Items	Description
S1	3730707	CHARGE OR CREDIT OR BANK OR MASTER OR STORE OR SHOP OR MERCHANT
S2	5500065	CARD OR ACCOUNT OR LINE OR CONTRACT? ? OR AGREEMENT
S3	141919	CHARGECARD? ? OR CREDITCARD? ? OR BANKCARD? ? OR VISA OR MASTERCARD OR AMERICAN()EXPRESS OR CHARGEACCOUNT? ? OR CREDITLINE? ?
S4	649197	UNHAPPY OR UNSATISF? OR DISSATISFIED OR DISPUT??? OR COMPLAIN??? OR ("NOT" OR NON OR UN)() (HAPPY OR SATISFIED OR CONTENT?? OR PLEASED) OR DISCONTENT?? OR DISPLEASED
S5	2798319	NEGO?IATI??? OR BARGAINING OR PARLEY??? OR HAGGL??? OR DICKER??? OR MODIFY??? OR MODIFI? OR ALTERNATIVE OR FLEXIBLE OR -CUSTOM OR CUSTOMI? OR MODIF? OR ADAPT? OR PERSONALI? OR INDIVIDUALI? OR TAILOR???
S6	7201274	TERM? ? OR PARAMET? OR INTEREST()RATE OR (MONTHLY OR MINIMUM)()PAYMENT OR TIME OR PERIOD OR CREDIT()LIMIT OR GRACE OR AMNESTY OR LATE()FEE OR TIMESPAN? ? OR DURATION?
S7	408502	S3 OR (S1(2N)S2)
S8	2167	S4(S) (S5(10N)S6)
S9	42	S7(S)S8
S10	132082	S5(7N)S6
S11	715	S7(10N)S10
S12	37	S4 AND S11
S13	62	S9 OR S12
S14	18	S13 NOT PY>1997
S15	16	S14 NOT PD=19970313:20050431
S16	15	RD (unique items)

16/3,K/1 (Item 1 from file: 476)
DIALOG(R)File 476:Financial Times Fulltext
(c) 2005 Financial Times Ltd. All rts. reserv.

0007512309 BOED2DAAHIFT

FT Quarterly Review of Personal Finance (20): Clarify your needs in the confusing world where everyone is doing everything - A profusion of overlapping services makes it hard to know where to turn, yet the dearth of impartial financial advice has pushed the onus of choice firmly on to the customer / High Street Investment

GILLIAN O'CONNOR

Financial Times, P XVIII

Friday, April 29, 1994

DOCUMENT TYPE: NEWSPAPER LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT

Word Count: 1,017

...and so on.

Current accounts and money transmission

Banks, building societies and customers are all **unhappy** about this key aspect of the market. The financial firms admit that they are really...

...drawback to many current accounts is the penal costs they impose on borrowing. Using a **credit card** to finance short- **term** borrowing is usually the cheapest and most **flexible** way of doing so, even if you have a card which charges an annual fee...

16/3,K/3 (Item 1 from file: 621)
DIALOG(R)File 621:Gale Group New Prod.Annou.(R)
(c) 2005 The Gale Group. All rts. reserv.

01376860 Supplier Number: 46357095 (USE FORMAT 7 FOR FULLTEXT)

AMERICAN EXPRESS OPENS ITS NETWORK TO U.S. BANKCARD ISSUERS

News Release, pN/A

May 2, 1996

Language: English Record Type: Fulltext

Document Type: Magazine/Journal; Trade

Word Count: 605

(USE FORMAT 7 FOR FULLTEXT)

TEXT:

Criticizes **Visa** Attempts to Restrict Bankers' Freedom of Choice NEW YORK, May 2, 1996--Harvey Golub, chairman and chief executive officer of **American Express** Company, today invited U.S. banks to join **American Express** in issuing consumer and corporate cards on the company's worldwide network. The decision to open the **American Express** network represents a significant new effort to expand **American Express** ' franchise through partnerships with banks and other financial organizations. In remarks delivered at **Credit Card** Forum, the card industry's largest annual conference, Mr. Golub said, "We're suggesting that (banks) view **American Express** as the provider of a network on which some or all of the cards they issue can operate." He said that bank relationships with **American Express** could include services such as: * Back-office systems * Operations * Back-office customer services * Credit management * Authorizations * Worldwide service network * Rewards platforms * Cardmember benefit programs Mr. Golub said that a recent **American Express** survey of U.S. **bankcard**

customers found that more than one in four respondents said they would like to learn more about the kinds of credit and charge cards that banks might develop with **American Express** or Discover, or would like the option of getting one of these cards from a bank. Mr. Golub said that working with **American Express** would meet customer needs while helping banks to strengthen their competitive position and increase revenues. One precedent cited was the arrangement **American Express** has with banks that sell its Travelers Cheques. "We supply the product, which the banks sell to their customers," Mr. Golub explained. Golub Criticizes **Visa** 's Anti-Competitive Practices Mr. Golub also criticized **Visa** for engaging in anti-competitive practices. " **Visa** USA's by-laws currently prohibit its members from dealing with the only two inter-system competitors it fears: **American Express** and Discover." He cited **American Express** research among **bankcard** executives of the top 300 Visa-issuing banks in the United States, which found: * Ninety-nine...

...third would be interested in issuing additional card products, like a co-branded card from **American Express** or Discover. * Nearly half said it was not in their bank's best interest to have **Visa** prohibit them from issuing card products from other associations. * Nearly half said they would be interested in offering a product with **charge card** economics to their customers. Sixty-two percent acknowledged the chilling effect on pursuing partnerships outside their current networks, saying that **Visa** by-laws make them less likely to consider issuing **American Express** or Discover cards. Mr. Golub said, "The heart of the issue is freedom of choice. Only **Visa** 's restrictive by-law stands between banks and their freedom to choose. "The kind of relationships we are looking to build will take **time** to forge. We are talking about **customized** arrangements that meet the specific requirements of bank issuers and their customers. It will require a good deal of discussion and planning, but we are eager to move ahead." **American Express** Company is a diversified worldwide travel and financial services company founded in 1850. It is...

...planning, investment products, insurance and international banking. [Editor's Note:] In January of this year, **American Express** filed a **complaint** charging that **Visa** International is engaged in anti-competitive activities in violation of the Treaty of Rome by advocating that banks issuing **Visa** cards be prohibited from also issuing **American Express** Cards. The **complaint**, filed with the European Commission in Brussels, asserts that **Visa** 's proposed new bylaw would limit card industry competition in Europe by restricting member banks...

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01993354 Supplier Number: 43577472 (USE FORMAT 7 FOR FULLTEXT)
Progress on SLGS is well sluggish--William Tucker
Public Finance Washington Watch, v7, n1, pN/A
Jan 11, 1993
Language: English Record Type: Fulltext
Document Type: Magazine/Journal; Trade
Word Count: 1883

... Treasury since 1972 long enough to get the bugs out.
Yet still, there is widespread **discontent**. In fact, its hard to find

many people anywhere who are terribly enthusiastic about SLGS...

...years. Outstanding volume for 1992 was only \$157.6, the lowest since 1988.

A typical **complaint** comes from Girard Miller, of Fidelity Investments, writing in the December issue of Investment Exchange...

...the bonds.

Enter SLGS. The Treasurys demand-deposit program is designed to work like a **bank account**. A municipality buys an odd-lot of Treasuries at an **interest rate tailored** to meet arbitrage restrictions. Then it can redeem the securities as needed.

Unfortunately, the program...

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0494639 SF003
THE SECRET TO BANK CREDIT CARDS REVEALED!

10:01 EDT WORD COUNT: 737

...carry a balance. If consumers choose to carry a balance, they are accessing an open- **line** of **credit** with incredibly **flexible terms**. Interest charges are incurred as they would be for any other type of consumer loan...

...effect, a no-interest loan. In fact, one out of every two dollars spent on **Visa** incurs no interest, he noted. When discussing the charge of "endless repayment," Heller said, "It's incredible that BHA **complains** about lower minimum payment requirements. The consumer is the best judge as to when and how he or she should use a **credit card**. The consumer chooses whether he or she wants to pay the bill in full and...

...is, the choice is theirs. Credit cards offer consumers a valuable payment device with incredibly **flexible** payment **terms**. Similarly, he noted, that BHA criticizes **bankcard** programs that allow consumers to skip a payment. "Again," he said, "this can be a..."

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FT Quarterly Review of Personal Finance (20): Clarify your needs in the
confusing world where everyone is doing everything - A profusion of
overlapping services makes it hard to know where to turn, yet the dearth
of impartial financial advice has pushed the onus of choice firmly on to
the customer / High Street Investment

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S5	2302738	NEGO?IATI??? OR BARGAINING OR PARLEY??? OR HAGGL??? OR DICKER??? OR MODIFY??? OR MODIFI? OR ALTERNATIVE OR FLEXIBLE OR -CUSTOM OR CUSTOMI? OR MODIF? OR ADAPT? OR PERSONALI? OR INDIVIDUALI? OR TAILOR???
S6	7929117	TERM? ? OR PARAMET? OR INTEREST()RATE OR (MONTHLY OR MINIMUM)()PAYMENT OR TIME OR PERIOD OR CREDIT()LIMIT OR GRACE OR AMNESTY OR LATE()FEE OR TIMESPAN? ? OR DURATION?
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00260871 (USE FORMAT 7 OR 9 FOR FULLTEXT)

United they stand ...

Minderman, Dean

Credit Union Management, v18, n4, p44-47+, Apr 1995 DOCUMENT TYPE:
Journal Article LANGUAGE: English RECORD TYPE: Abstract Fulltext
WORD COUNT: 01987

...ABSTRACT: unit. At the \$230-million Seven Seventeen Credit Union
(Warren, Ohio), for example, employees were **dissatisfied** with the way the
then-manager was restructuring the credit union and filling newly created
...

...the area belong to unions, credit union employees are more likely to
seek a collective **bargaining agreement**. **Credit** union executives
agree that over **time**, unions and management can figure out how to work
together. Two-way communication is key.

18/3,K/2 (Item 2 from file: 268)
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00025061

Industry says cardholders not being gouged on fees

Anonymous

Financial Services Report, v9, n15, p1-4, Jul 22, 1992 DOCUMENT TYPE:
Newsletter Article LANGUAGE: English RECORD TYPE: Abstract

ABSTRACT: Facing allegations they charge higher than apparent rates, **bank**
card issuers contend current disclosure is ample, customer payment
behavior determines interest and fees assessed, and payment **terms** are
flexible. Meanwhile, many banks have lowered card interest rates and
reduced minimum monthly payments on cards...

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Are Two Better than One?

Bargaining Behavior and Outcomes in an Asymmetrical Power Relationship

F. ROBERT DWYER*

Many consumer transactions are characterized by bargaining between parties holding unequal power positions. The group polarization hypothesis suggests that the effects of group size will differ for high- and low-power bargainers. Accordingly, power position and size of bargaining unit (one, two) were manipulated in a threat-vulnerable 2×2 game. Factor effects on economic performance, communication style, and post-bargaining attitudes were examined at the unit and system levels. Supporting the group polarization hypothesis, two-person groups tend to magnify the power manipulation—i.e., group size interacts with power position on post-bargaining attitudes and system performance.

Although administered prices and mass merchandising characterize the majority of consumer exchanges in post-industrial societies, an important subset of consumer transactions is preceded by bargaining behavior (Johnston and Bonoma 1983). Defined as "haggling over the terms of give and take" (Stephenson 1981), bargaining involves disagreement ("haggling") as parties seek agreement over the terms of their exchange (hence the "give and take"). Consumers are party to bargaining activity in automobile showrooms, prior to in-home transactions, at flea markets, in durable goods shopping (Pennington 1968), and when seeking post-sale redress. To the extent that consumers occasionally use these settings for disposing of products, they may haggle as sellers as well as buyers.

Recent writings in the popular press have highlighted the viability of haggling over terms and with merchants not commonly thought to be open to negotiation (cf. Cohen 1980; Fletcher 1980). Consumers may obtain discounts when paying with cash instead of bank cards, and they may leverage price breaks or additional items when buying in quantity or assembling a package (e.g., audio or computer components). Consumers may also obtain price, service, or delivery concessions on defective or slow-moving merchandise. Many buyers tend to expect some degree of flexibility from local retailers. For example, neighborhood merchants verify the tendency of elderly patrons to request "senior citizen discounts." Thus, while

recognizing the predominance of seller-administered terms of sale, the prevalence of consumer bargaining seems to justify its study by consumer researchers.

GROUP BARGAINING

An important question in many bargaining situations concerns what parties and how many "come to the table" (Raiffa 1982). In the consumer arena it is common for in-home salespeople to insist on the presence of both husband and wife during the presentation. The neophyte in automotive mechanics will take along a well-versed friend when the car needs to go to the shop for major repairs. The salesperson on the floor will "check with the manager" regarding a used car trade-in allowance. We might similarly acknowledge class-action suits, citizen alliances, and political action committees (PACs) as consumer activities which bring groups to bargaining forums otherwise occupied by independent individuals.

The Power Relationship

Most exchange relationships in society are characterized by an unequal power distribution between the parties (Dwyer and Walker 1981; Johnston and Bonoma 1983). It is difficult to envision a bargaining setting where each party has the same dependence position, negotiating skills, credibility, expertise, and outcome at stake. The prevalence of seller-administered terms of trade reflects, in part, a power advantage held by retailers vis-à-vis consumers. A retailer usually has numerous potential patrons, a reasonably skilled selling staff, and market and competitor information. An individual consumer cannot so easily shop at alternative suppliers, acquire product information

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from nonretail sources, or allocate the costs of search across multiple transactions.

Importantly, the consumer is not destined to the weaker role in all exchanges. Some transaction environments bring a power advantage to consumers (e.g., dealing with the overstocked auto dealer in a recession). Moreover, there are usually generic strategies available to the weaker party (buyer or seller) for reducing dependence on the powerful exchange partner. Foremost in the repertoire is cultivation of new exchange partners. For example, the consumer who dislikes the escalating terms on his/her checking account at the local bank might move his/her account; the visiting professor who rents his/her home while on leave can evict and replace the tenant whose rent is tardy. Other coping strategies are for the weaker party to lower his/her stake in the outcome of the exchange, to secure a resource on which the stronger party is highly dependent, or to coalesce with other weak parties to "countervail" the power of the stronger party.

Yet because there are costs inherent in these coping strategies, a great many unbalanced relationships endure, and the skewed distribution of rewards from the exchange relationship means that the potential for conflict is ever-present. It behooves the stronger party to exercise his/her advantage judiciously, thus preventing flare-ups and the initiation of actions by the weaker party that might permanently alter the power structure; similarly, it is incumbent upon the weaker party to develop effective threats. Of course threats—i.e., exercise of the above coping strategies—are costly to carry out, but they need not be fulfilled if the threatener is believed (Schelling 1960). Unfulfilled threats will reduce credibility, while costly threat fulfillment may be necessary to establish credibility (Tedeschi, Schlenker, and Bonoma 1973) and hence may reduce the need to carry out threats in the long run (Baldwin 1971). The following vignettes may make these abstract concepts more tangible:

A young executive is annoyed by a testy note that she has exceeded the credit limit on her bank card. When she offers to return the "lousy credit card," the bank increases her credit limit.

Early Saturday evening, a grocery store manager looks forlornly at the large number of loaded shopping carts abandoned by consumers who were intolerant of the day's long checkout lines. Some of the frozen foods have thawed. "Don't these people realize they'll just have to shop again?" he sighs. "We'd better accelerate our plans for improved checkout staffing and procedures."

Research Paradigm

Although it is hoped that consumer researchers will someday study individual versus group power-position effects "in situ," it is fitting that our initial inquiries be directed toward specific and controlled features. To this end, the 2×2 paradigm simplifies the mixed-motive characteristics of an exchange to their most tractable form (Rapoport, Guyer, and Gordon 1976). The scenarios just

FIGURE
PAYOFF MATRIX FOR THE BARGAINING GAME

		Column		
		A	B	
Row	A	8 / 20	20 / 15	
	B	-2 / 6	15 / -2	
		Key		
		Row Payoffs		Column Payoffs

NOTE: For example, if the person entitled Row chooses A while Column chooses strategy B, Row receives \$20 while Column receives \$15. This figure is adapted with permission from Melvin Guyer and Anatol Rapoport (1970), "Threat in a Two-Person Game," *Journal of Experimental Social Psychology*, 6 (January), p. 13.

outlined are representative of many power distributions in consumer bargaining and depict what Rapoport and Guyer (1966) have labeled the "threat vulnerable game." The Figure shows the specific structure of the game (taken from Guyer and Rapoport 1970) that is utilized in this study.

Each player (designated Row and Column) has only two options, labeled A and B. Choices are made without knowing the other's strategy; it is the intersection of decisions that determines the outcome. The lower left number in each cell represents Row's payoff and the number in the upper right triangle represents Column's.

Given the availability of diverse brand and store choices for consumers and alternative target markets for sellers, superficially this dyadic structure seems like a critical sacrifice of process reality for experimental cleanliness (Aronson and Carlsmith 1968). But as previously mentioned, consumers may employ numerous coping strategies short of ending an exchange relationship. We can complain to the *maitre d'* at our favorite restaurant if the food is below par, and we may occasionally patronize the closest supermarket even though the aisles are too crowded with freestanding displays. It can also be argued that the payoff values in the matrix implicitly depict the opportunity cost of exchange relations for the parties. For example, resembling the plight of Row, a consumer wishing to buy an exclusively distributed product can only travel a great distance or forego the product if unsatisfied with the current exchange terms.

To study networks of exchanges, we must first understand the basic acts of exchange between pairs of bargainers. The proposed game is a potent analogy—particularly to show what has been left out of previous consumer research, rather than to claim how much can be packed into a 2×2 paradigm, since "By definition, an analogy is different from the real thing—otherwise it would not be an analogy but the real thing itself" (Schlenker and Bonoma 1978, p. 21).

"Strict rationality" predicts Column A and Row A decisions in this study's "analogy," because for both sides

these choices yield payoffs greater than option B, regardless of the decision of the opposing side. Thus there is an overriding dominant strategy for both Row and Column in each play of the game. However, decisions AA result in Column receiving its highest payoff and Row receiving its next-to-lowest; hence the game favors Column. In the next section, a theoretical justification is provided for labeling Column the high-power position and Row the low-power or weaker position.

At this point the threat-vulnerability aspect of the game deserves explanation. Over repeated trials of the game, the weaker unit (Row) may depart from strict "rationality" and shift from A to B. In this cell (BA), the high-power unit (Column) receives its next-to-lowest payoff; thus Row has threatening power over Column (recall the young executive who did not have to fulfill an explicit threat and the frustrated shoppers who exercised their capacity to "punish" the grocer for poor service).

Faced with Row's possible move from A to B, which constitutes a threat to Column, Column can do one of two things. As the high-power unit, it can continue selecting decision A and settle for its next-to-lowest payoff, or Column can switch to decision B. When Row chooses A and Column chooses B (cell AB), Row receives its highest payoff while Column receives its next-to-highest. Row can carry out its threat by selecting decision B and settling for its lowest payoff until Column moves to decision B, or Row can revert to decision A if Column refuses to accede.

A cooperative strategic choice behavior is also possible. If Row continually selects decision A and Column shifts back and forth between decisions A and B, both players would receive relatively high payoffs. This style of play appears to be equitable to both players and yields higher joint profits by avoiding the low-profit BA cell.

Although the 2×2 threat-vulnerable game's resemblance to "haggling over the terms of give and take" may not be immediately obvious, most buyer-seller negotiations pivot on the same strategic dilemma that subjects face in this game. While anchoring another variant of the 2×2 paradigm, Stephenson offered a cogent argument for such games of partial conflict:

Over time, by cooperation, (subjects) achieve more than by pursuing jointly competitive and exploitative strategies . . . such research may have something to say about the development of bargaining relationships, or indeed, of other relationships in which strategic interdependence is a significant factor (Stephenson 1981, p. 173).

Thus the game is a useful tool for testing specific predictions derived from theories of power and bargaining (Schlenker and Bonoma 1978).

POWER

Since Aristotle (357 BC), power has been the topic of countless essays and discussions about what it is, how to get it, how to use it, and how to cope with it. With varying

degrees of scholarly precision, these works have been brought to bear on issues ranging from diplomacy, politics, inter- and intraorganizational relations, family decision making, and other interpersonal and intergroup influence settings. Thus a comprehensive review of power is beyond the scope of this article.

Fortunately, this limitation does not leave us at a dead end; rather, it magnifies the importance of specifying the particular conceptual avenue one chooses for studying power. In their comprehensive review of the bargaining literature, Rubin and Brown (1975) report that most of the studies which manipulate the balance of power have done so by altering either payoff matrices or experimental reward structure. In such studies, power is measured by the extent to which one party can affect the range of outcomes the other receives (Tedeschi et al. 1973). Thibaut and Kelley (1959) specified two types of control in such games—fate control and behavior control. With *fate control*, the controlling party can determine the outcome for the other irrespective of the dependent party's behavior. When one party can vary its behavior in such a way as to make it desirable for the other to vary its behavior, their relationship is characterized by *behavior control*.

In the threat-vulnerable game in the Figure, neither party has behavior control over the other. For both players, choice A brings higher payoffs than choice B regardless of the opponent's choice. With regard to fate control, power also seems reasonably balanced—that is, within the A column, Row can alter Column's payoffs by 14 ($20 - 6 = 14$), and along the A row, Column can affect Row's payoffs by 12 ($20 - 8$).

It is important to note the bargaining inertia caused by joint decisions stemming from the strictly rational play previously described. The high-power party is the party that always emerges with a maximal payoff when both parties choose the alternative that maximizes their respective payoffs; the low-power party is that party that ends up with a less than optimal payoff when both parties attempt to maximize their gains. In the aforementioned consumer examples, bringing the credit card balance back within preestablished limits and waiting through the Saturday checkout lines manifest "strictly rational" moves of low-power players.

Beyond the setting-specific definition of power, it does not seem strained to anchor the power distinction of this study in Emerson's (1962) conception of a generic reciprocal relationship between power and dependence (see also Cook and Emerson 1978). That is, A's power over B rests on the extent to which B is dependent on A for valued resources. In the threat-vulnerable game, Row depends on Column doing something not "rational"; only then can Row maximize its earnings. Meanwhile, Column depends on Row to be rational. In the course of repeated plays, Row is expected to grow frustrated, sacrifice "rationality," and utilize its fate control by choosing strategy B (which is costly to exercise), thereby inducing Column to choose B and thus obtaining behavior control of Column (Thibaut and Kelly 1959). On empirical grounds,

TABLE 1
OVERVIEW OF SMALL GROUPS PROCESS/PERFORMANCE RESEARCH

Issues/ subissues	Summary of conceptual and empirical research	Relevance to current study
Audience effects	The presence of others has arousal consequences (Shaw 1976). By increasing the generalized drive state, one might enhance the dominant response—e.g., Zajonc and Sales (1966) demonstrated that weak habits are inhibited while stronger habits are facilitated by the presence of others. "The mere presence of an audience (including psychological presence) motivates bargainers to seek positive and avoid negative evaluation" (Rubin and Brown 1975, p. 44).	An important phenomenon that seems to coincide with the generalized group-polarization effect.
Third-party intervention	Walton (1969) has outlined guidelines for effective conflict management through either "process consultation" or redress of "dysfunctions in social relationships."	Possibly relevant in mediated consumer/supplier disputes (legal and extralegal) but not to the current study.
Judgment task performance	When judgments come after group discussion, they are seldom less accurate than the average individual judgment or more accurate than the most proficient group member (Shaw 1976).	Although it is not difficult to envision bargaining situations where division of labor and creative inputs are relevant, group learning is not expected to play a significant part in the chosen design.
Problem solving	Although if few individuals can solve a problem (syllogistic reasoning, puzzle) it may not help to work in groups, generally groups produce more and better solutions than individuals. The group may require more time to reach a solution (Shaw 1976).	
Learning	Groups will learn more than individuals in tasks on which several persons can work without getting in one another's way, which can be solved with the addition of individual contributions, and in which parts of the solution are at least partially independent (Yuker 1955).	
Brainstorming	Groups with brainstorming instructions (Osborn 1957) produce ideas indefinitely, whereas individuals "run dry."	
Coalitions	"By coalition we mean two or more parties who act jointly to affect the outcomes of one or more other persons" (Thibaut and Kelley 1959, p. 205). See also Caplow (1968).	Imagine two consumer bargaining scenarios: (1) two neighbors jointly negotiate for lawn service with a company representative, (2) husband and wife negotiate terms for lawn service with a company representative. The former situation comprises a coalition in the Thibaut and Kelley tradition. The essence of the latter is captured in the current study.
Social loafing	People tend to expend less effort in a group than they do when alone in a variety of situations: shouting, rope pulling, brainstorming, swimming, and artistic creativity (Latané, Williams, and Harkins 1979; Jackson and Padgett 1982). This concept encompasses the "free rider" phenomenon. People do not want to contribute fully to a public good if they cannot be excluded from the use of that public good.	The simplicity of the focal task and its cognitive (vis-à-vis physical) emphasis dilute the potential relevance of social loafing as a conceptual framework for the issues of this study.

extensive work with the threat-vulnerable game in the Figure has led Rapoport, Guyer, and Gordon (1976) to dub Column the "top dog."

INDIVIDUALS AND GROUPS

The vast literature on small group processes defies detailed review in this paper; only the group polarization phenomenon—the chief conceptual framework for the study—is amply developed here. Table 1 outlines the major research areas from which to map subissues and flag potential elements for an ultimate contingency theory of power structure/group size. It also provides cryptic

summaries of the evidence and cites key conceptual and interpretive work.

Group Polarization

Myers and Lamm (1976) credit Stoner (1961) with initiating a wave of investigations of group risk-taking by examining the popular notion that groups are more cautious and less daring than individuals. Stoner had six persons at a time respond as individuals to a series of story problems, advising a fictional character as to how much risk s/he should take in a particular dilemma. After individually marking their advice on the entire battery

of items, subjects assembled as a group and discussed each item until they agreed. Stoner found that groups were more risky than their average individual member.

Subsequent research has shown that the label initially attached to Stoner's discovery—the "risky shift" phenomenon—was a misnomer. An important finding from the choice dilemma studies which followed is that individual items differ from one another in (1) mean initial response, and (2) mean shift, and that the two are highly correlated. Items that elicit relatively risky initial tendencies generally yield further shift toward the risky extreme after group discussion, while items with initially cautious responses shift to even greater caution after discussion.

Myers and Lamm (1976, p. 603) couch these findings in more general terms under the *group polarization hypothesis*: "The average postgroup responses will tend to be more extreme in the same direction as the average pregroup responses." These authors go on to examine group discussion experiments using the group polarization hypothesis across other response dimensions. In general, the hypothesis holds up well in all seven of their study categories: attitudes, jury decisions, ethical decisions, judgments, person perceptions, negotiation behavior, and risk measures other than choice dilemmas.

Although not subjected to competitive tests in this research, three theoretical approaches have been utilized to explain the phenomenon—group decision rules, interpersonal comparisons, and informational influence. Past research shows strongest support for the latter two viewpoints.

Also, although the polarization hypothesis per se has been tested in only a few negotiation studies, a number of studies have identified individual group differences in bargaining.

Two experiments by Lindskold, McElwain, and Wayner (1977) typify this latter group. Male and female subjects, either as individuals or as groups, participated in a 50-trial Prisoner's Dilemma (PD) Game, so named for its parallel to the situation of two apprehended partners in crime who in isolation have the choice of confessing or remaining silent; length of sentence is a consequence of joint decisions. Subjects could communicate either with threats or punishment for target noncooperation or with promises of their own cooperation. In Experiment I bargainers opposed a live target, and in Experiment II they opposed a simulated target who was either highly (67 percent) or 50 percent cooperative in response to the subject's messages. Groups were more competitive than individuals and more strongly preferred the use of threats. Post-experimental ratings of the simulated target indicated a polarization of impressions in the groups. To explain their findings, these authors conjectured:

If the prevailing response in the PD is competition (Oskamp, 1971), the difference between groups and individuals can also be interpreted as a behavioral manifestation of the general choice shift phenomenon in groups (Myers and

Lamm, 1976) which results in group members being more polarized in the preferred or valued direction . . . (Lindskold et al. 1977, p. 539).

Indeed, this perspective brings added understanding to previous research by Pylyshyn, Agnew, and Illingworth (1966) and Lindskold, Gahagan, and Tedeschi (1969) that found polarization phenomena among multiperson opponents.

In an important theory test, Stephenson and Brotherton (1975) assigned 96 mining supervisors to one-on-one or two-on-two discussion groups whose purpose was to define their work role. In the two-on-two situation, both the character of debate and the outcomes were distinctly different from what occurred in the one-on-one condition. There was less conflict and a tendency to compromise in the dyad, whereas in the four-person groups, one side or the other tended to win and the group as a whole would polarize.

In another theory test in the context of a labor-management simulation study, Rabbie and Visser (1972) utilized three-man union teams who were made to believe they had either a very strong or a very weak bargaining position. For half the groups a cooperative orientation was induced; the other half had a competitive orientation. In preparation for the intergroup negotiations, participants were asked to indicate their individual aspirations for three bargaining issues that were presumed to vary in importance. After a group discussion, their collective aspirations were measured. Across all conditions (weak/strong, cooperative/competitive), groups set significantly higher aspiration levels than did individuals on the most important bargaining issue and were more conservative on the less important issues. Most pertinent to the present study were significant or near-significant interactions for all three bargaining issues between bargaining strength and the direction of the group-induced shift:

In the strong bargaining condition, groups set higher aspiration levels than the average of prior individual judgments; in the weak bargaining condition the opposite trend occurred (Rabbie and Visser 1972, p. 401).

Although hardly consumer focused, Rabbie and Visser's work is important because it addresses the issues of power position and group effects on bargaining that are raised in the present study, which investigates these phenomena when:

1. Parties hold an *individualistic* orientation—probably more pertinent for consumer transactions than strictly cooperative (coordination) or competitive (diplo-military) inductions, and
2. When parties themselves are aware they are bargaining with an individual or a group.

We already have evidence from Lindskold et al. (1977) that individual bargainers opposing groups rate their opponents as less likable and less credible than similar bargainers opposing individuals. That study provided no power position insights, however, and did not manipulate

the size of the bargaining group for both dyadic parties. The interactions reported by Rabbie and Visser thus point to the appropriateness of further study.

The present study compares the bargaining processes and outcomes of one-person and two-person parties. Although it would be reckless to extend this study's conclusions about one- versus two-person bargaining to *n*-person processes, comparing one- and two-person parties is appropriate both because the literature provides empirical and theoretical grounds for expecting differences between these two levels of "group" size, and because a survey of group memberships revealed that 92 percent of all groups observed were comprised of just two or three members (James 1951).

HYPOTHESES

Unit Level

The laboratory setting of this study allowed measurement of three important aspects of bargaining relationships: (1) economic outcomes, (2) communication processes, and (3) post-bargaining dispositions. The effects of power position on these dimensions have been highly consistent. The Rubin and Brown (1975) review and the Cook and Emerson (1978) framework (dubbed "power theory") provide the foundation for hypothesizing that an asymmetrical distribution of power will produce asymmetrical negotiations, with the more powerful member dominating the bargaining:

- H1:** Relative to their weaker opponents, strong bargainers will:
- earn higher payoffs
 - communicate less frequently
 - be more favorably disposed toward their own rewards and bargaining, their opponents, and the bargaining situation.

To clarify Hypothesis 1b, the greater number of messages from weak to strong members manifests a type of substitute locomotion (Thibaut 1950). This process is explicated by Schopler and Bateson (1965), who argue that self-reference in terms of "powerlessness" or dependency may sometimes be the basis of power—for example, a blood bank can appeal to the conscience of a potential donor in a face-to-face solicitation in order to gain an adequate supply.

This logic might ordinarily be extended to anticipate stronger units sending more demanding and/or threatening messages (Dwyer and Walker 1981). But due to the structure of the matrix in the threat-vulnerable game, it does not behoove powerful members to threaten unless a weaker party has already instigated or carried out threats.

Our understanding of group effects on bargaining is relatively shallow compared to our understanding of power effects. Group size can nevertheless be expected to interact with power position, with the polarization

phenomenon effectively magnifying the power manipulation:

- H2:** In comparison to one-person strong units, two-person strong units will—and in comparison to two-person weak units, one-person weak units will:
- earn higher payoffs
 - be more demanding in their communications
 - hold more favorable dispositions toward their own rewards and bargaining, their opponents, and the bargaining situation.

Although Lindskold et al. (1977) found that individual bargainers rate multiperson opponents as less likable and credible than individual opponents, this author uncovered no theoretical basis for hypothesizing effects from opposing group size:

- H3:** Whether a bargaining unit's opponent is comprised of one or two persons will have no effect on that unit's:
- payoffs
 - communication style or frequency
 - disposition toward its own rewards and bargaining, opponent, and bargaining situation.

System Level

If the group polarization phenomenon occurs as hypothesized above, then the condition with the smallest *de facto* discrepancy in power between the two units occurs in the one-on-one situation. Rubin and Brown (1975) have offered convincing evidence for the proposition that an equal-power situation is more efficient than the unequal base. Therefore:

- H4:** The one-on-one condition will:
- earn the highest system payoffs
 - produce the fewest system threats
 - obtain the most favorable post-bargaining system attitudes toward its own rewards and bargaining, opponents, and the bargaining situation.

While it is impossible to hypothesize about the two-on-one and one-on-two conditions, the two-on-two condition—as the most unbalanced power structure—should be least efficient:

- H5:** The two-on-two condition will:
- earn the lowest system payoffs
 - produce the most system threats
 - obtain the least favorable post-bargaining system attitudes toward its own rewards and bargaining, opponents, and the bargaining situation.

METHOD

Subjects

Subjects were 108 undergraduate business students at a state university in the Midwest. In addition to receiving a \$2.00 fee for participating, each subject had the opportunity to increase his or her earnings by generating points in the game. Specifically, subjects were told to maximize their own (\$) profits and that 1.0 percent of their cumulative payoffs would be added to (subtracted from) their earnings. Such supplements averaged \$2.43, with each player receiving the payoffs garnered by his/her team.

Subjects were randomly assigned to one of eight (2×2) treatments (i.e., to the weak or strong power position, as a one- or two-person team, opposing a one- or two-person team). Subjects in any one bargaining group worked in a room from which they could not see their bargaining opponents (although they could, obviously, see their bargaining partner). The design was balanced in that there were nine pairs of bargaining units for each of the one-on-one, two-on-one, one-on-two, and two-on-two system conditions. Table 2 clarifies the design while showing the gender composition of treatments. At each power position within the treatments, there were no differences between males and females on payoffs.

The Game

Whereas Guyer and Rapoport's (1970) subjects could "communicate" only through actions/choices over 300 trials, here subjects had the opportunity to send standardized written messages back and forth via a moderator, so fewer trials were required to convey their intentions and expectations. Pilisuk and Rapoport (1964) reviewed many studies utilizing the Prisoner's Dilemma paradigm and consistently identified a "lock-in" effect. This is the tendency of bargainers to initiate a pattern of mutual competition or cooperation early in their relationship and then persist for the remainder of the interaction. Two psychological effects determine the presence and extent of "lock-ins": self-enhancing behavior is repeated, and self-inhibiting patterns are likely to be broken. In the former case, the more an outcome has been repeated, the more likely repetitions are to be continued; in the latter, the more repetitions occur, the more likely the run is to be broken. However, the lock-in pressures in the game used in this research are enigmatic:

In a game with a threat-vulnerable natural outcome, . . . the interesting question is whether runs of (BA) are self-enhancing or self-inhibiting. In favor of the former conjecture would be a growing reluctance on the part of Row to 'give up' his revolt against Column, while Column persists more and more in (A) on the assumption that the mounting losses will force Row to give up. In favor of the self-inhibiting conclusion is the possibility that mounting losses do exert increasing pressure on Row to give up, or Row's

TABLE 2

GENDER COMPOSITION OF TREATMENTS DESIGNATED BY GROUP SIZE IN LOW AND HIGH POWER POSITIONS^a

One-on-one	One-on-two	Two-on-one	Two-on-two
M, F (3) ^b	M, MF (4)	MF, M (5)	MF, MF (4)
F, M (3)	F, MF (3)	MM, F (2)	MM, MF (1)
F, F (2)	M, FF (1)	MM, M (1)	FF, MF (1)
M, M (1)	F, FF (1)	FF, M (1)	MM, FF (1)
			MF, MM (1)
			MM, MM (1)

^a Number of replicates in parentheses.

^b Read: In the one-on-one condition, there were three bargaining systems in which a male in the low-power position opposed a female in the high-power position.

continued revolt exerts an increasing pressure on Column to 'yield' (Rapoport, Guyer, and Gordon 1976, p. 109).

Hence, while 20 trials was judged (hoped) sufficient for developing patterns of interaction, the analysis did have to make comparisons with previously reported longer runs and check for changes from early to later play.

Although a wide variety of communications can transpire in consumer negotiations, this study used standardized messages to preclude the mobilization of personality and writing skills as sources of influence (even from isolated bargainers) and to avoid the appraisal of these same factors in order to "size up" one's opponent. Subjects could choose from five standardized messages:

- "Unless you choose option _____, I will select option _____."
- "If you chose option _____, I will select option _____."
- "Would you please select option _____ so I can select option _____?"
- "Okay."
- "No way."

These forms were developed in line with the idea that efficient communication between bargainers must contain expectations, intentions, and contingent statements (Deutsch 1958; Rubin and Brown 1975). Using Schelling's (1960) distinction that a threat is costly to the sender if not believed (punishment for noncompliance) while a promise is costly to the sender if it is believed (reward for compliance), the first two messages were coded as threat and promise, respectively.

Bargaining sessions lasted for 1 minute (except for the first five, which lasted 2 minutes to facilitate orientation to game mechanics). After each session ended, both sides were instructed to fill out decision sheets (i.e., select either option A or option B). Once the moderator had recorded the message content and pattern and the decision choices, resulting payoffs, and cumulative payoffs for each side, he gave each side a sheet of paper indicating payoffs for that session, cumulative payoffs, and opponent's decision choice.

A session could end either because both sides chose not to communicate any more or because time ran out, at which point decisions were collected by the moderator. Although groups frequently chose not to communicate to the extent allowed in the game, it was seldom as a consequence of time pressure or two persons deadlocked on a team. It is therefore unlikely that length-of-run effects prompted reduced bargaining aspirations on the part of the subjects.

As soon as a session was completed, the next one began, with the opposite side having the opportunity to send the first message. Although 20 such sessions were run for each group, subjects were not told exactly how many sessions would be run until the final one was completed.

To start the game, subjects entered a room where they were isolated from their bargaining opponent(s). The subject or subject team was provided with written instructions about the game, a payoff matrix, and a supply of standardized messages. After subjects' questions as to how to read the payoff matrix and communicate via the standardized messages were resolved, the game began with Row having the first opportunity to send a standardized message.

After 20 sessions had been run, subjects filled out questionnaires intended to measure their attitudes toward various facets of the game. Specifically, subjects were instructed to indicate their attitudes toward (1) the simulation itself, (2) their rewards from the game, (3) their opponent(s), and (4) themselves in the game on sets of multi-item semantic differential scales.

RESULTS

In accord with the hypotheses, analyses were performed on two primary levels, team (or unit) and system. First, payoffs, communication style, and post-game attitudes were examined at the team level. We then estimated the effects of the three factors—power position, size of own unit, and size of opposing unit—and their interactions on eight dependent variables that fell into three categories:

- | | |
|--------------------------------|--|
| 1. Economic performance | —cumulative (20 trial profits earned) |
| 2. Communication process | —number of messages sent
—number of threats issued
—number of promises made |
| 3. Post-bargaining disposition | —attitude toward one's self
—attitude toward own rewards
—attitude toward one's opponent
—attitude toward the game itself |

The attitude scales and their respective alpha reliability coefficients are reported in the Exhibit.

Before addressing the findings in detail, one analytical quirk that stems from the design must be discussed. Al-

though treatments and post-bargaining attitudes are "attached" to individual subjects, payoffs and communication variables are the consequence of *team* actions. Ignoring this distinction double-counts 36 data points and inflates the degrees of freedom in the analysis. For any two-person team, therefore, the attitude data from the two subjects were averaged. The effective sample size for the team level analysis is then 72, with nine *systems* for each treatment (one-on-one, etc.), and with each dyadic position providing dependent measures.

Table 3 presents the summary results of the multivariate analysis of variance (MANOVA). Clearly, the effects of power position are quite strong on the set of dependent variables. Also, there is a significant two-way interaction between power position and group size on the criterion vector. Both effects seem to support the power position and polarization hypotheses, but three important caveats must be raised. First, Box's M test for homogeneity of variance indicates heteroscedasticity in the data, in part from using averaged attitude scores in the two-person teams. Although transformations for stabilizing variance were considered, they were rejected in light of adverse consequences on interpretability (Neter and Wasserman 1974). There is also evidence to believe that MANOVA is fairly robust with regard to the homoscedasticity assumption, especially in balanced designs, although there is a possibility that the significance is slightly overstated (Harris 1975).

Second, the analysis was repeated twice due to concern about the stability of 20 periods of play. The first analysis utilized profit accumulated in the first 10 trials, while the second used the sum of payoffs from trials 11 through 20. Overall, the only difference was a slightly stronger power position \times own team size interaction in the second period model. The performance of individual variables was virtually identical in the two analyses, except for a significant power position effect on number of threats in the first period model—which is washed out in the second period—and slightly stronger power position effects in the second period model. Finally, the distribution of joint decisions is very similar to that obtained in the 10 300-trial runs reported in Guyer and Rapoport (1970):

Strategic choice (row, column)	(A A)	(A B)	(B A)	(B B)	Total
Present study	55	23	17	5	100%
Guyer & Rapoport data	64	24	9	4	100%

Inferred length-of-run effects might be that early trials are characterized by players jockeying for position or testing one another. Of course, other differences in the two studies—communication opportunities and the use of team players—could also be the impetus for more "threats" by Row.

EXHIBIT
ATTITUDE MEASUREMENT SCALES

Toward the simulation itself:

interesting/dull
challenging/easy
understandable/confusing
fair/unfair
boring/engrossing
accommodative/competitive
mechanical/strategic
playable/unplayable

(alpha = 0.59)

Toward my rewards from the preceding simulation:

good/bad
fair/unfair
adequate/inadequate
superior/inferior
motivating/frustrating
rewarding/penalizing
reasonable/unreasonable
ineffective/effective
uncertain/certain
low/high
unbiased/biased
inflexible/flexible
insufficient/sufficient
annoying/pleasant

(alpha = 0.95)

Toward opponent's action in the preceding simulation:

vigorous/feeble
changeable/stable
harmonious/dissonant
courteous/discourteous
careful/careless
congenial/quarrelsome
selfish/unselfish
belligerent/peaceful
unpleasant/pleasant
weak/strong
foolish/wise
uncooperative/cooperative
excitable/calm
obstructive/helpful
bad/good

(alpha = 0.86)

Toward me at this task in the preceding simulation:

optimistic/pessimistic
positive/negative
fresh/stale
contented/discontented
spirited/lifeless
motivated/frustrated
lively/sluggish
rewarded/penalized
dissatisfied/satisfied
feeble/vigorous
inattentive/attentive
discouraged/encouraged
unsuccessful/successful
ineffective/effective

(alpha = 0.93)

NOTE: All items utilized graphic rating scales with a 100 mm line between polar adjectives. Except for attitude toward simulation, the scales are taken from Dwyer and Walker (1981).

TABLE 3
**POWER POSITION AND GROUP SIZE EFFECTS ON ECONOMIC,
COMMUNICATION, AND ATTITUDE CRITERION VECTORS***

Source	Wilks' λ	Approximate F
Power position (A)	.371	12.087 ^b
Own team size (B)	.871	1.054
Opposing team size (C)	.948	.394
A \times B	.753	2.337 ^c
A \times C	.888	.898
B \times C	.916	.651
A \times B \times C	.920	.619

* Degrees of freedom in this fixed effects model are 8 and 57.

^b Significant at $p < 0.001$.

^c Significant at $p < 0.05$.

The third caveat regards the essence of most multivariate procedures: while the structure of a problem determines the appropriateness of their use, interpretation often requires multiple univariate analyses. Tables 4 through 6 support this effort. Table 4 shows the Pearson

correlations between all dependent variables. Payoffs are highly correlated with attitudes and negatively correlated with number of threats. Not surprisingly, the four attitude scales share a significant proportion of variance, and the number of threats and promises issued are positively related to the number of messages sent.

The relationships among the dependent variables are an important backdrop for Table 5, which summarizes the univariate and Roy-Bargman step-down analyses (Roy and Bargman 1958). This latter procedure is similar to stepwise regression, in that it computes each successive F -value only after eliminating the effects of the previous dependent variables. If the criterion variables were uncorrelated, this would amount to a series of univariate F -tests. Since the dependent variables already have been shown to be collinear, their order of entry in the model is important.

Implicit in the order of entry in Table 5 is the view that economic performance and communication style shape post-bargaining attitudes. Also, since the power position variable was operationalized by manipulating

TABLE 4
CORRELATIONS AMONG DEPENDENT VARIABLES^a

	Payoffs	Messages	Threats	Promises	Attitude ^b toward rewards	Attitude ^b toward self	Attitude ^b toward opponent
Messages	-.021						
Threats	-.251 ^c	.252 ^c					
Promises	.082	.322 ^d	.095				
Attitude toward rewards	.588 ^d	-.103	-.223	.122			
Attitude toward self	.630 ^d	-.079	-.208	.058	.633 ^d		
Attitude toward opponent	.290 ^a	.009	-.097	.089	.419 ^d	.246 ^c	
Attitude toward game	.325 ^d	-.083	-.083	.180	.574 ^d	.483 ^d	.342 ^d

^a n = 72.

^b Two-person teams utilize average of both subjects' perceptions.

^c Significant at $p < 0.05$.

^d Significant at $p < 0.01$.

^e Significant at $p < 0.02$.

TABLE 5
SUMMARY OF ROY-BARGMAN STEPDOWN AND UNIVARIATE F-TESTS OF POWER-POSITION AND GROUP-SIZE EFFECTS
ON ECONOMIC, COMMUNICATION, AND ATTITUDE CRITERION MEASURES

Dependent variables	Method ^a	Error ^b	Source						
			Power position (A)	Own team size (B)	Opposing team size (C)	A × B	A × C	B × C	A × B × C
Payoffs	S	64	64.47 ^c	.55	.59	5.68 ^c	.02	.12	.01
	U		64.47 ^c	.55	.59	5.68	.04	.12	.01
Messages	S	63	.14	.08	.98	.16	.03	1.27	.03
	U		.10	.07	.96	.13	.04	1.31	.04
Threats	S	62	2.13	2.21	.20	.02	.05	.50	.07
	U		.01	2.79 ^c	.79	.31	.05	.20	.05
Promises	S	61	.07	.16	.02	1.02	.97	.61	.11
	U		.23	.07	.04	.90	.78	.17	.07
Attitude toward rewards	S	60	3.00	2.20	.00	.11	.99	.79	.84
	U		23.20 ^c	.63	.22	1.90	.52	.59	.69
Attitude toward self	S	59	.37	2.06	.32	.53	.36	.69	.66
	U		23.17 ^c	1.70	.89	3.44 ^a	.73	.09	.69
Attitude toward opponent	S	58	12.66 ^c	.15	.63	1.42	4.74 ^d	1.14	.48
	U		.03	.00	.78	.01	1.93	.13	.01
Attitude toward game	S	57	.30	1.00	.55	8.85 ^c	.01	.20	2.71
	U		3.93 ^d	.01	1.12	10.73 ^c	.00	.07	2.16

^a S = step-down; U = univariate.

^b Degrees of freedom in step-down tests.

^c Significant at $p < 0.01$.

^d Significant at $p < 0.05$.

^e Significant at $p < 0.10$.

the payoff structure (as opposed to communication channels, status, and so on), the effects of profits were considered before any other variables. However, a model that has disposition shaping style of play which, in turn, affects economic performance is also plausible, as is an inter-

active, dynamic system. Therefore, univariate *F*-tests are also provided in Table 5. These values ignore the collinearity in the criterion set.

Table 6 provides cell means and marginals for power position and own team size for each dependent variable.

TABLE 6
SUMMARY OF CELL MEANS ON ALL DEPENDENT MEASURES^a

Power position	One-person own team			Two-person own team ^b			
	(1) One-person opponent	(2) Two-person opponent	(3) (1 + 2)/2 average	(4) One-person opponent	(5) Two-person opponent	(6) (4 + 5)/2 average	(7) (3 + 6)/2 average
Strong							
Payoffs	290	287	289	320	305	312	301
Number of messages	16.7	20.0	18.3	18.3	18.1	18.2	18.3
Number of threats	1.33	1.56	1.44	1.56	2.44	2.00	1.72
Number of promises	5.56	4.44	5.00	5.56	5.56	5.56	5.28
Attitude toward rewards ^c	61.8	68.5	65.2	75.6	70.7	73.1	69.1
Attitude toward self	71.3	68.6	69.9	81.0	83.1	82.1	76.0
Attitude toward opponent	57.6	47.0	52.3	55.6	48.7	52.1	52.2
Attitude toward game	58.3	60.1	59.2	71.7	64.1	67.9	63.6
Weak							
Payoffs	212	203	207	171	154	162	185
Number of messages	17.1	19.4	18.3	19.2	19.0	19.1	18.7
Number of threats	1.11	1.33	1.22	2.11	2.55	2.33	1.78
Number of promises	5.00	5.78	5.39	3.89	4.89	4.39	4.88
Attitude toward rewards	54.9	50.3	52.6	52.6	48.4	50.5	51.6
Attitude toward self	62.0	55.2	58.6	60.0	53.0	56.5	57.6
Attitude toward opponent	52.1	53.1	52.6	51.6	54.4	53.0	52.8
Attitude toward game	65.8	59.7	62.7	53.4	53.9	53.7	58.2
Average of power positions							
Payoffs	251	245	248	245	229	237	243
Number of messages	16.9	19.7	18.3	18.8	18.6	18.7	18.5
Number of threats	1.22	1.44	1.33	1.83	2.50	2.17	1.75
Number of promises	5.28	5.11	5.19	4.72	5.22	4.97	5.08
Attitude toward rewards	58.3	59.4	58.9	64.1	59.6	61.8	60.3
Attitude toward self	66.7	61.9	64.3	70.5	68.1	69.3	66.8
Attitude toward opponent	54.8	50.1	52.4	53.6	51.6	52.6	52.5
Attitude toward game	62.1	59.9	61.0	62.6	59.0	60.8	60.9

^a n = 9/cell. One vs. two-person opponent effects are insignificant and marginals are omitted for clarity.

^b Attitude scores from two-person teams are the average of both subjects' dispositions.

^c High scores indicate favorable attitudes.

These descriptive data facilitate interpretation of the effects flagged as significant in Table 5.

Power Effects

The absence of power position effects would cast serious doubts on the efficacy of the power manipulation. The data allay these concerns, however. First, subjects clearly indicated their perception of Column's leverage on the exit questionnaire: on a graphic rating scale of the statement, "bargaining position is advantageous to self/opponent," Column held the perceived advantage ($Z = 6.32$, $p < 0.001$). Moreover, Table 3 shows that power position is the only multivariate main effect in the model.

Tables 5 and 6 provide directional confirmation of the hypothesized effects on payoffs and dispositions. Bargainers in the strong position earned about 68 percent more than those in the weak and had more favorable dispositions toward their own rewards, selves, and the game (supporting Hypotheses 1a and 1c). There was no

evidence in support of the hypothesized power effects on communication. Thus weak members do not use communication as substitute locomotion (Thibaut 1950).

Group Size Effects

The essence of Hypothesis 2 is an anticipated interaction between power position and size of own bargaining unit, whereby group size magnifies the consequences of the power manipulation on payoffs, communications, and attitudes. Focusing on the power position \times own-team-size column ($A \times B$) of Table 5, significant interactions on payoffs and dispositions toward self and opponents are evident. Table 6 is useful for explicating the nature of these interactions.

Thus, two-person strong units earned more than individual strong bargainers. Two-person weak units, on the other hand, earned less than their solitary counterparts (supporting Hypothesis 2a). There are no interaction effects on communications, although the absence of power

position effects (rejecting Hypothesis 1b) here makes predictions of polarization enigmatic. Similarly, two-person strong units are more favorably disposed toward themselves and the game than their one-person counterparts, while the opposite holds for two- and one-person weak bargainers (supporting Hypothesis 2c).

While opposing group size has no multivariate effect (supporting Hypothesis 3), before closing out this appraisal of individual level effects there are two other results that merit discussion. Because these effects were not hypothesized, post hoc explanations are all that can be offered for what may be *chance* effects. Still it seems judicious to capitalize on the exploratory potential of this study and speculate on their meaning for future research.

First, the only main effect from group size is on the number of threats: two-person units issued more threats than one-person bargainers. Perhaps two-person units are likely to feel less bound by social norms of cooperativeness because responsibility is diffused across two individuals (Latané and Darley 1968; Turner and Giles 1981). Alternatively, the increased threats could reflect the above phenomenon plus deteriorating morale and frustration among two-person units.

Second, there is an interaction between power position and number of opponents on attitude toward opponent. With just a few calculations, the nature of the interaction can be gleaned from Table 6. Basically, two-person opponents are highly evaluated by weak bargainers and denigrated by powerful units. Individual weak bargainers are perhaps more likely to be viewed positively by their more powerful opponents than are weak two-person bargaining units. This may be due to a referent power phenomenon (French and Raven 1959). Powerful bargainers may identify with their "gutsy," "independent," "underdog" opponent. In parallel, perhaps a two-person team "legitimizes" its having the opposing strong position. This prompts more cooperative play and more positive dispositions toward the simulation by one-person weak and two-person strong opponents.

System Level Effects

To examine the effects of group size at the different power positions on systems performance and morale, new criterion and predictor variables were defined. Corresponding to payoffs in the previous analysis is the sum of the profits of the weak and strong side bargainers in each 20-period session. Numbers of messages, threats, and promises are now the system totals of the team communication variable counterparts. The affective variables are the average post-bargaining attitudes from each position in each system: whether the averages come from two, three, or four subjects, *each power position gets the same weight*. The independent variables denote the size of the bargaining unit in the weak and strong positions plus their interaction.

Although this analysis provides a useful perspective on system performance, it is worth a moment to reflect on

the essence of the dependent variables. The model considers the dispersion not of interunit but of intersystem response variables. That is, this model treats as identical a system response variable—say attitude toward opponent (an appealing indicator of conflict/harmony)—whether it's 30 from weak, 80 from strong, or 50/60 respectively.

Applied to the system level data, MANOVA produced no significant effects. This should not be surprising since the lone main effect from the team level MANOVA—power position—is irrelevant for the system model. At the same time, the error degrees of freedom are more than halved.

The univariate tests indicate three marginal effects from the size of the weak bargaining unit. In accord with the theoretical expectancies, one-tailed tests were applied. Bargaining systems with single subjects in the weak position produce about 12 percent higher joint payoffs than systems with two-person weak units ($t(34) = 1.63, p < 0.06$). The group polarization hypothesis is supported by this result.

Similarly, there are weak-size effects on the use of threats in the system ($t(34) = 1.56, p < 0.07$) and attitude toward the game ($t(34) = 1.95, p < 0.03$). System threats are more prevalent when two people occupy the weak power position. This is in line with our expectation that groups would magnify the power manipulation which, in turn, would produce less efficient (more conflictive) bargaining. The significant affective measure shows greater satisfaction with the game when the weak bargaining unit consists of a solitary individual.

The absence of the opposite (interaction) effects from the size of the strong unit does not support the polarization paradigm. However, recalling that weak bargainers evaluate their two-person opponents much more highly than do solitary opponents, we might postulate that there is a group perception phenomenon beyond the polarization phenomenon. Perhaps tied to some source of social influence (identification or expertise) or the data aggregation procedure, this phenomenon obfuscates the polarization hypothesis at the system level.

CONCLUSION

Power Hypotheses

The hypothesized effects of power position were strongly supported. Bargainers in the strong position earned more than those in the weak position. This verifies the power manipulation in the game. Power position seemed to have no effect on the extent or style of communications. Weak members did not use communication as a substitute locomotion. Strong members did not make more threats, but again, the inherent structure of the game did not particularly encourage strong unit threats.

Post-bargaining attitudes of strong-position bargainers were significantly higher than those of their opponents. Table 5 shows that power position affects attitudes both directly and indirectly, through payoffs.

Group Size Hypotheses

The significant interactions between power position and size of own team support a generalized polarization phenomenon. Extrapolating from univariate tests, it is apparent that polarization occurs primarily on payoffs and affective variables. Size of own bargaining unit tends to magnify the profit and attitude consequences of the power manipulation—i.e., two-person strong units earn more and hold more positive attitudes toward the game and themselves than do their single equivalents. For two-person weak units, the opposite effects occur.

The interaction effect did not appear on any of the communication variables. However, independent of position effects, groups did tend to issue more threats, and this is consistent with the expectation of groups to feel less bound by a cooperative norm; social responsibility is diffused across two individuals. Finally, there are hints of a group perception effect which interacts with power position.

Consumer Research Implications

Although this study was conducted in a laboratory using student subjects and a relatively simple paradigm, it began investigation of an important field of inquiry for consumer researchers. Indulging in reckless extrapolations from this work, one could recommend, for example, that husband and wife shop for an automobile together in a buyers' market, individually in a sellers' market. Similarly, consumer complaints about service or merchandise from a large retailer might be more effectively lodged by an individual than by a couple of patrons; at a small neighborhood shop, the reverse should apply—the couple would be predicted to fare better.

The temptation to generalize must be resisted, however, until a multitude of critical questions can be addressed. Can we expect these effects to be tempered by the complexity of the issue(s)? Clearly, bargaining for recompense with a cable TV service is different from negotiating an automobile purchase. In addition to the discrete exchanges generally depicted in laboratory designs and the above vignettes, we ought also to examine whether polarization holds for long-run relationships that might characterize exchange patterns for dental or financial services.

Other questions might include: is there a temporary polarization phenomenon subsequent to coalition formation? What sort of paradigm is appropriate for simulating interorganizational negotiation? What interpersonal forces are brought to bear in intergroup conflict? What about more complex exchange relationships (networks) than this study's bilateral monopoly situation? These questions are pertinent to consumer research and are sufficiently challenging to engage researchers' attention in both the laboratory and the field over the next decade.

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QUANTITATIVE METHODS IN CREDIT MANAGEMENT: A SURVEY

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Many static and dynamic models have been used to assist decision making in the area of consumer and commercial credit. The decisions of interest include whether to extend credit, how much credit to extend, when collections on delinquent accounts should be initiated, and what action should be taken. We survey the use of discriminant analysis, decision trees, and expert systems for static decisions, and dynamic programming, linear programming, and Markov chains for dynamic decision models. Since these models do not operate in a vacuum, we discuss some important aspects of credit management in practice, e.g., legal considerations, sources of data, and statistical validation of the methodology. We provide our perspective on the state-of-the-art in theory and in practice.

A few statistics, gathered from various sources, show the enormous economic incentive for better techniques for credit management: From 1976–1979, the Bell System's bad debt for residence telephone users doubled, going from \$128–\$256 million. More troubling, bad debt as a percentage of billing rose by 50% over the same period. This problem led to the development and deployment of credit management techniques by AT&T (Showers and Chakrin 1981, Kolesar and Showers 1985). Turning to other industries, in 1978, consumer receivables totaled \$276 billion for installment credit, \$64 billion for noninstallment credit, and \$760 billion for single family mortgage credit (while the U.S. government's debt that year was \$780 billion) (Chandler and Coffman 1979). In 1985, the combined VISA/MasterCard worldwide charge volume was \$183 billion, up 2% from the previous year (Gist 1986), and credit cards were believed to account for about 2% of consumer spending (up from 0.35% in 1976) (Matthews 1985). Credit card losses in 1985 are estimated at \$1.8 billion in the U.S. (1.5% of volume) and \$2.1 billion worldwide, and are predicted to be \$4.7 billion for the U.S. and \$6.3 billion worldwide by 1990. In the third quarter of 1990

credit card delinquency increased by 16% from the previous quarter, and were 27% higher than 5 years ago (*Wall Street Journal* 1991). Lastly, in 1991 about \$1 billion of Chemical Bank's \$6.7 billion in real estate loans are delinquent, and the bank holds \$544 million in foreclosed property; Manufacturers Hanover's \$3.5 billion commercial property portfolio is burdened with \$385 million in nonperforming loans (Hammer and Shenitz 1991).

To minimize credit losses, a variety of credit management techniques have been developed. The decisions addressed by these techniques fall into two categories. The first category is the decisions of whether or not to extend credit, and how much credit to extend. The second category is those decisions pertaining to an existing account, including: raising or lowering the credit limit; authorizing a specific charge (for a charge card); how long a period to reissue a new charge card for when the cardholder's current card expires; how the account should be treated with regard to promotional/marketing decisions; and deciding when action should be taken on a delinquent account (i.e., determining the "start treatment level") and what action should be taken. Typical collection

Subject classifications: Finance, corporate finance: bankruptcy prediction. Financial institutions, banks: credit analysis. Statistics, data analysis: discriminant analysis.

Area of review: OR PRACTICE.

strategies include: do nothing; use a regular statement to include a reminder; send a computer generated message; send a personal letter; make a telephone call; or assign the account to an outside collection agency. While some of these decisions may apply only to charge cards, in general these decisions apply to many types of credit, including mortgages, retail installment credit, commercial loans, and consumer loans.

Many advantages accrue through the use of quantitative methods for credit management. First, there are obvious benefits from optimally making the decisions specified above: More creditworthy applicants are granted credit (or additional credit), thus increasing profits; more noncreditworthy applicants are denied credit (or given reduced credit), thus decreasing losses; and optimal collections policies minimize the cost of administering collections or maximizing the amount recovered from the delinquent account. In addition, there are indirect advantages, including: applications can be processed quickly; the decisions are objective and not based upon human biases or prejudices (this fairness is crucial in view of antidiscrimination laws in credit granting); the profitability of the lending institution can be tied explicitly to the credit decisions; management has easy control over the system, so that changes in policy can easily be incorporated into the software rather than disseminated through meetings and paper; and fewer people are needed to administer credit granting, and the more experienced people can concentrate on difficult cases (Galitz 1983).

Most of the techniques used in practice utilize a "score" computed for each applicant or existing account to determine the decision. Therefore, much of the credit literature deals with "application scoring" (for the first category of decisions) or "behavior scoring" (for the second category). The intent of applicant scoring is to forecast the future behavior of a new credit applicant; behavior scoring tries to predict the future payment behavior of an existing account. The terms applicant score and behavior score are traditionally used in the context of discriminant analysis, which is, by far, the most common quantitative technique in credit management and which, accordingly, receives the most attention in this survey. Other techniques used and surveyed here are decision trees, expert systems, neural networks, dynamic programming, integer programming, linear programming, and Markov chains.

Credit management is currently as much of an art as a science. While the accept/reject decision for a new applicant is well defined and most amenable to

quantitative analysis, the other decisions are not as easy to formulate and are much less studied, and subjective judgment rather than empirical models appears to be the norm. Indeed, Coffman and Chandler (1983) observed that behavior scoring lacks the widespread use and the industry acceptance that applicant scoring enjoys. Another 1983 paper reports on a survey showing that only one third of the companies surveyed use credit scoring for other than application scoring (Nelson 1983).

Scoring systems utilize information relating to the traditional 5Cs of credit: (1) character (the willingness to repay debt), (2) capacity (the financial ability to repay debt), (3-4) capital and collateral (possessions or equities from which payment might be made), and (5) conditions (reflecting the general economic environment, or special conditions applying to the borrower or the type of credit) (Savery 1977, Sparks 1979, Galitz 1983). The data for scoring systems are obtained through questions on, e.g., the length of time at current address or with current employer, present salary, number of dependents, other loan commitments, and occupation. In addition, behavior scoring typically utilizes information on delinquency during the performance period (a specified period over which performance is observed, e.g., the past 12 months), account activity during the performance period, account balance during the performance period, amount past due, returned checks, age of account, new applicant credit score, and credit bureau data (e.g., past due balances, derogatory information, inquiries) (Coffman and Chandler).

While there have been some excellent papers on various aspects of credit management methods, such as those by Eisenbeis (1977, 1978) on discriminant analysis, these papers assumed a prior knowledge of discriminant analysis. This paper assumes no prior knowledge. Moreover, there are no previous comprehensive surveys of quantitative methods other than discriminant analysis (i.e., surveys that span decision trees, expert systems, and the several dynamic methods that have been proposed). Also, previous mathematically-oriented papers did not delve into such practical issues as sources of data, validation of systems, and regulatory requirements.

The literature search started with a search of the on-line Management Contents and ABI Inform data bases and led to more than 100 papers. The subject of credit screening has even appeared in the theoretical economics literature (Stiglitz and Weiss 1981, Bester 1985). Despite the best of intentions, we clearly could not review every related paper: Lachenbruch's (1979)

classic book on discriminant analysis has 579 references. Many important papers were listed in Zanakis, Mavrides and Roussakis (1986).

This paper is intended to be a comprehensive review of every major mathematical technique in the literature, and to provide some links between the theory and practice of credit management. This review's sole theme is to bring the area of quantitative methods in credit management to the attention of operations research professionals. We have tried to include all important contributions without excessive subjective commentary, preferring each reader to decide for himself or herself what techniques will ultimately be most useful.

This paper is organized as follows. In Section 1 we review the theory and application of discriminant analysis in credit management, including basic theory, choosing the cutoff point, problems in applying discriminant analysis for credit scoring, a review of some interesting case studies using discriminant analysis, and an extension to multiple discriminant analysis models. This section is extensive for two reasons. First, discriminant analysis is, by far, the major quantitative tool in credit analysis. Second, it is not part of the traditional operations research or introductory statistics curriculum. Section 2 provides an example of applying discriminant analysis. In Section 3 we describe integer programming approaches to scoring. Section 4 briefly reviews decision trees, and Section 5 considers some expert systems and neural networks developed for credit management. Section 6 reviews dynamic models for credit decisions, including Markov chains models for account aging, methods for deposit policies, acceptance and credit limit decisions, and start treatment level and collection decisions. Section 7 examines some aspects of credit scoring in practice, including validating the scoring system, sources of credit information, and legal considerations. Section 8 provides an example of the Markov chain approach. Concluding remarks are in Section 9.

1. DISCRIMINANT ANALYSIS

In this section we will review the classic theory of discriminant analysis (DA) and discuss problems in implementing DA, especially when applied to the credit classification problem.

1.1. Basic Theory

Let the population consist of two groups G and B ; a member of G or B is called an *observation*. In the credit granting decision G and B are the sets of

"good" and "bad" customers. Let p_G (respectively, p_B) be the proportion of G (respectively, B) in the population. Let c_G be the cost of misclassifying a member of G (i.e., incorrectly assigning it to B) and let c_B be the cost of misclassifying a member of B (i.e., incorrectly assigning it to G). Let x be the vector of independent variables to be used to decide whether an observation is in G or B .

Consider the important special case where the density $f_G(x)$ is multivariate normal with mean μ_G (where $\mu_G \in R^N$), $f_B(x)$ is multivariate normal with mean μ_B , and $f_G(x)$ and $f_B(x)$ have the same N by N covariance matrix Σ . Thus,

$$f_G(x) = (2\pi)^{-N/2} (\det \Sigma)^{-1/2} \cdot \exp \left[-1/2(x - \mu_G)' \Sigma^{-1}(x - \mu_G) \right].$$

Usually we do not know μ_G or μ_B . We can estimate μ_G by \bar{x}_G , where \bar{x}_G is the (componentwise) average of a sample known to belong to G . Similarly, we can estimate μ_B by the average \bar{x}_B , and Σ by the matrix S computed using the samples known to belong to G and B . Then the sample-based classification rule is: Assign x to G if

$$\begin{aligned} \bar{L}(x) &\equiv [x - 1/2(\bar{x}_G + \bar{x}_B)]' S^{-1}(\bar{x}_G - \bar{x}_B) \\ &> \ln ((c_B p_B)/(c_G p_G)) \end{aligned} \quad (1)$$

and assign x to B otherwise. Since this rule is linear in x , the technique is called linear discriminant analysis (LDA). Figure 1 illustrates LDA: With $N = 2$, we see the subsets of the good and bad populations accepted at two cutoff scores. Figure 2 illustrates the good/bad tradeoff: For each possible percentage of "goods" accepted (corresponding to some cutoff score), there is a smaller percentage of "bads" accepted.

Clearly, the choice of c_B and c_G has a major effect on the classification results of DA. However, the computation of these costs is often the most difficult problem in applying DA (Morrison 1969). Even today, many banks are only now beginning to incorporate costs into the cutoff score calculation (Fair Isaac Companies 1988). The calculation of c_B and c_G is also tied to the problem of defining which are the "good" and "bad" observations, because these definitions may involve calculating the profit of each account. A consistent methodology should be used for both of these issues.

There is little formal published methodology on computing c_B and c_G , especially with regard to the multiperiod consequences of misclassification (as discussed in Section 6 on dynamic models, the costs should reflect downstream consequences of erroneous decisions, rather than simply the immediate

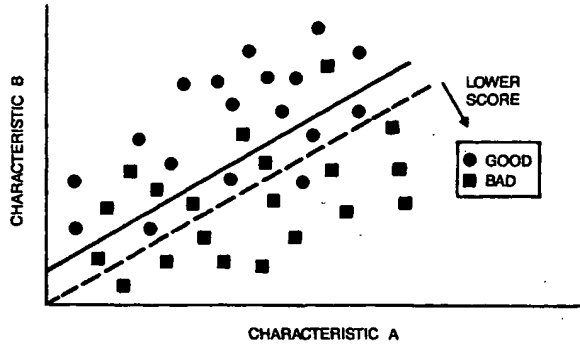


Figure 1. Discriminant analysis.

costs). Also, any cost methodology would necessarily be industry specific, including such features as different tax treatment. In addition to the difficulty of determining costs, the lack of published formal methodology is probably due, in large part, to the fact that a detailed cost analysis is likely to be proprietary.

Another perspective to DA is provided by Beranek and Taylor (1976). Let $I(x) \equiv a'x$, where $a \in R^N$. Let $\lambda_G(\lambda_B)$ be the marginal revenue (cost) per dollar of credit for good (bad) accounts (they also consider a third category of delinquent accounts that is treated similarly and which we ignore for simplicity). Let $P(G|I)$ (respectively, $P(B|I)$) be the conditional probabilities of an account with characteristics x being good (respectively, bad) given $I(x) = I$. Here $P(G|I)$ (respectively, $P(B|I)$) is assumed to be increasing (respectively, decreasing) in I and $P(G|I) + P(B|I) = 1$ for all I . Their rule is to accept all customers scoring I as long as the expected profit per dollar of credit is positive, i.e., if

$$P(G|I)\lambda_G - P(B|I)\lambda_B \geq 0. \quad (2)$$

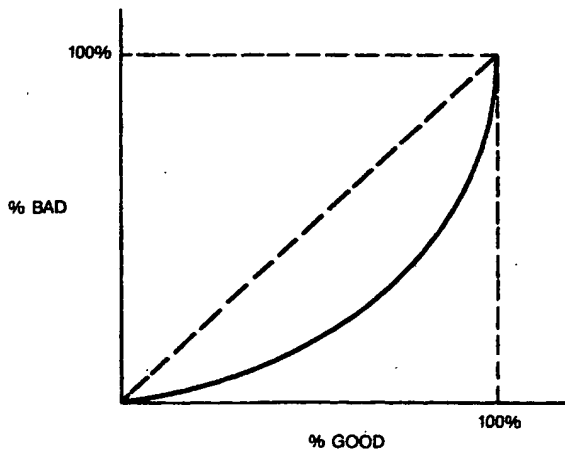


Figure 2. Good/bad tradeoff.

The cutoff I^* is the value of I for which the left-hand side of (2) is zero; thus I^* solves

$$P(B|I^*) = P(G|I^*)(\lambda_G/\lambda_B).$$

Neither one of the cutoff rules (1) or (2) is totally satisfactory. They both suffer from the fact that the costs are assumed to be constant for all x . This is not true in general: The lost revenue from misclassifying a good customer is not the same for all customers. Also, the cost of misclassifying a bad customer is not constant: Part of this cost is the collection cost of past due accounts, and different collection strategies, with different costs, may be optimal for different subsets of the population. For example, based on the characteristics x (and possibly the past due amount) it might be more appropriate to use a mail reminder rather than a more expensive collection agency; the difference in these collection costs yields a different c_B in (1) and λ_B in (2). Another example of nonconstant λ_B occurs when x contains categorical data (i.e., $x_j = 1$ if the person has a telephone and $x_j = 0$ otherwise); in the latter case a telephone collection strategy is not available.

The optimal cutoff score can also be determined indirectly by determining the number of applicants that should be accepted or determining the maximum allowable probability of default. Greer (1967) presents a model for determining the optimal number x of credit applicants that should be accepted by a creditor, rather than the usual problem of determining which credit applicants to accept. He presents profit and opportunity cost models that require substantial data, including specifying the proportion of credit customers that default as a function of x . Fixed costs are included. The opportunity cost is convex in x for the sample data presented, and the x minimizing opportunity cost is shown to maximize credit profits. An example is presented for which profits equal $49.74x - 19.91(10^{-5})x^{2.2} + 16.95(10^{-11})x^{3.4} - 4.63(10^{-17})x^{4.6} - 1.97(10^{-24})x^{5.8}$.

A second strategic model by Greer (1968) casts the problem as determining a retailer's maximum acceptable probability of default. He expresses the expected profits from accepting a credit applicant as the sum of 11 costs or revenues, 7 of which are linear in p , the expected probability of default of an applicant. Theoretically, retail creditors can then solve for that p value above which the expected economic profit is negative, and applicants having an estimated probability of default above this value are rejected. The probability of default for an account can either be

formed subjectively or through credit scoring, because the number of bad accounts in each score interval can be used to compute the probability of default for that score interval. Greer notes that one drawback of this approach is that the parameters used in determining the cutoff p may in fact vary with p . A heuristic suggested in this case is to segment the accounts by a given range of values of a priori estimates of default probability (e.g., one group might have a priori estimates of 0.4 to 0.5) and compute a cutoff p value for each group.

A program for penetrating a new market may call for lowering the cutoff score if management is willing to accept more short-term losses in the hope of a market share in the future. Often, two cutoff points are used: If the score falls below the lower cutoff, the applicant will be rejected; if the score exceeds the upper cutoff, the applicant is provisionally approved (pending only a credit bureau check). If the score lies between, additional information (usually a credit bureau report) is obtained and the decision is re-evaluated (Day 1978, Galitz 1983). It is interesting to note that, although this two-cutoff point method appears to be popular, no theoretical justification has been published. Harter (1973), in developing an LDA rule for accepting mortgage loans, notes that, given a fixed amount of money available at a bank for mortgages, the cutoff score can be adjusted so that the total loan amount approved does not exceed the available money. For bank credit cards, offering a low interest rate to attract customers also reduces bank profits; this can be compensated for by lowering risk (e.g., raising the cutoff score) (Gist 1986).

A detailed discussion of the computation of c_B (but not c_G) for commercial bank loans is given in Altman (1980). Stone (1972) also considers the detailed economics of bank loans and shows that the cost of a bank loan to a firm is a step function of the loan size. Gentry (1974) notes that charge-offs on credit can rank behind payroll costs and interest on borrowed funds as the highest expense to a firm. Concerning c_G , for retail credit the opportunity cost for rejecting a good credit risk can include the potential increase in spending over current levels due to increased store loyalty, finance charges on store spending, and a possible decrease in spending due to customer irritation at being denied credit. For bank credit, c_G represents lost interest. Boyes, Hoffman and Low (1989) develop a model of credit card lending that shows how expected earnings on revolving credit card loans depend both on maintained balances and the probability of default. They estimate default probabilities using Manski and Lerman's "exogenous sample maximum

likelihood estimator," which maximizes a weighted log likelihood function with weights determined by comparing sample proportions with corresponding population frequencies.

1.2. Problems in Applying Discriminant Analysis for Credit Scoring

Several authors have expressed sharp criticisms regarding the use of discriminant analysis in credit scoring. Many of these criticisms are really problems inherent in credit scoring. Capon (1982) cites several severe methodological problems: Since the scoring system is developed from a sample of people given credit, it is not unbiased when applied to people seeking credit (this problem is discussed in detail below); development of scoring systems with too small samples; and the use of arbitrary judgment when credit scorers assign an applicant to a category (e.g., is an executive assistant clerical or managerial). Galitz observes that, because scoring systems usually treat people with similar characteristics identically, important exceptions may be missed. For example, renting a home is generally considered less creditworthy than owning, but some occupations (e.g., police) may provide rented housing as part of the job; these people should not be penalized. This problem has often been addressed through the use of interaction variables.

Eisenbeis (1977, 1978) critically reviews many of the credit scoring methods reviewed in this paper as well as others. The 1977 paper (with 82 references) also delves into advanced statistical concepts relevant to DA (see also Eisenbeis and Avery). The 1978 reference list of 63 entries is a valuable guide to further nontechnical or moderately technical reading on DA in general, and especially the use of DA in credit decisions. In both papers Eisenbeis identifies and discusses seven types of statistical problems in credit scoring models (an eighth problem is mentioned in the 1978 paper). In the remainder of this section we discuss the views of Eisenbeis as well as other researchers on these problems.

1.2.1. Group Definition

The most severe problem, according to Eisenbeis (1977), is in group definition. Discriminant analysis procedures are appropriate under the assumption that groups are discrete and identifiable (e.g., good or bad customers). Eisenbeis argues that groups should be defined only if natural breaks or discontinuities appear in some variable. Otherwise, segmenting the variable destroys valuable predictive information.

If no natural grouping occurs, it is possible to use regression procedures by selecting a value S and classifying a case as bad if the estimated profitability is less than S , and good otherwise. This has the inherent weakness of being subjective: Different managers may select different cutoff values S even if presented with exactly the same economic conditions. Furthermore, as those economic conditions change, S needs to change, but there seems to be no general objective procedure to do this.

If natural breaks occur, it is not likely that the good and bad categories will change dramatically. (Will creditors change their definitions because costs have risen slightly?) Thus, DA methods are relatively robust, which is a very good feature because otherwise new rules need to be created with each small change in conditions.

1.2.2. Population Priors

The second most severe problem cited by Eisenbeis is that discriminant analysis assumes known a priori population probabilities (e.g., p_G and p_B in Section 1). Most models simply assume equal population probabilities; some use the sample proportions as estimates of population priors, which works if the sample is a random sample from the population. If the sample is not a random sample of the overall population, using sample proportions minimizes the classification errors for the sample, but is biased for the population.

The problem of determining population probabilities becomes more severe when data from a single time period are used to estimate group membership in a future time period: If the population priors vary over time it is not clear what the population priors should be or how they should be estimated (e.g., the number of banks in financial trouble recently has increased greatly).

Experiments by Wagner, Reichert and Cho (1983) indicated that the use of population priors minimized the number of misclassifications, compared to equal priors: The overall accuracy increased from 70.8% to 73.2% for their 3-group model. Thus, a real-world model can be improved by the use of better estimates of the a priori group probabilities.

1.2.3. Unequal Covariance Matrices

The third most severe problem cited by Eisenbeis is that LDA also assumes that the covariance matrices of the two distributions (e.g., $f_G(x)$ and $f_B(x)$ in Section 1) are equal. If they are unequal, quadratic rules are necessary. Several studies comparing LDA and QDA on distributions with unequal dispersions showed that significant differences can occur; results

of the two procedures diverge as the difference in the dispersions and the number of variables increase.

1.2.4. Measuring the Effectiveness of Discriminant Analysis

The fourth most severe problem cited by Eisenbeis concerns measuring the effectiveness of DA. Predicting model performance is generally accomplished using the holdout method: The LDA rule is developed with some fraction of the data, and performance is estimated with the remaining data, known as the holdout sample. Theoretical studies on the effectiveness of holdout samples suffer from scant data (Scott 1978).

Another way to study the discriminating power is through the proportional reduction in error (PRE) measure. Imagine a game in which we randomly draw people from a population and guess whether they are G or B . We can do this knowing nothing (chance) about them or knowing their scores using LDA. If LDA is of value, the cost (or probability) of error using LDA should be smaller than using chance. We define the cost reduction as:

$$\text{PRE} = \frac{\text{the cost of error by chance} - \text{the cost of error by LDA}}{\text{the cost of error by chance}}$$

Two chance methods stand out.

Method 1. Guess B with probability p_B and guess G with probability p_G . This has the expected error cost

$$C_P = c_B p_G p_B + c_G p_B p_G = (c_B + c_G) p_B p_G$$

and is related to the statistical measure tau.

Method 2. Guess B if $c_B p_B \geq c_G p_G$ and guess G otherwise. Here $c_B p_B$ (respectively, $c_G p_G$) is the expected cost if everyone is classified as G (respectively, B). This has the cost of error $C_M = \min(c_B p_B, c_G p_G)$ and is related to the statistical measure lambda.

For LDA, the cost of error is

$$C_{\text{LDA}} = c_B p_B \frac{\text{the number of } B \text{ put in } G}{|B|} + c_G p_G \frac{\text{the number of } G \text{ put in } B}{|G|}$$

It is instructive to apply these measures to Altman's classic study of corporate bankruptcy (Altman 1968), which used equal population priors and equal costs. Altman and Eisenbeis (1978) revised this study using $p_G = 0.99$, $p_B = 0.01$, $c_G = 2$, and $c_B = 70$, yielding $C_{\text{LDA}} = 0.0630$, $C_P = 0.7128$,

and $C_M = 0.70$, which shows that LDA is superior to the two chance methods. In fact, $PRE_P = 0.912$ and $PRE_M = 0.910$, showing a 91% reduction in the cost of errors by using LDA rather than either chance method.

If costs are ignored by setting $c_G = c_B = 1$ and the sole objective of LDA is to maximize the percentage correctly classified, then the results of DA should be compared to C_M . If LDA does not do better, then it is better to classify everyone as belonging to the larger of the two groups. However, since LDA is typically used to classify observations into both groups, the results should generally be compared against C_P (Morrison). Morrison also observes that when one group is much larger than the other, and sample proportions are used in the LDA rule, fewer will be classified in the smaller group than actually belong in it. Thus, since there is often substantial interest in the smaller group, interpreting the results of LDA is difficult with groups of very different size. (See also Joy and Tollefson 1975, 1978 and Lachenbach and Mickey.)

1.2.5. Nonnormal Distributions

The multivariate assumptions in LDA are often violated, especially with categorical data; hence, the validity of using LDA is open to question. Violations of normality may bias the estimated error rates. Testing whether the distribution is multivariate normal is hindered by the fact that most tests are for univariate normality only.

One known way to overcome the problem of non-normal data is to abandon discriminant analysis for a generalized linear model known as the logit model (McCullagh and Nelder 1983, Nikbakht and Tafti 1989). Given the vector x of credit data for an applicant, the probability p of default is computed by

$$\log \left(\frac{p}{1-p} \right) = b_0 + \sum_{i=1}^N b_i \log(x_i).$$

One advantage of this model over LDA is that maximum likelihood estimation can be used to estimate the parameters b_i , $0 \leq i \leq N$. Logit models have rarely been used in credit management; one study by Wiginton (1980) found the logit model to be slightly superior to LDA, but found both to have poor predictive ability for the data studied.

Eisenbeis (1977) discusses several studies on the robustness of DA under different distributional assumptions. Logarithmic transformations have been used to make more symmetric the skewed distributions of such data as loan size or firm size. Wagner, Reichert and Cho used natural log transformations for

the five continuous variables in their 3-group (good/bad/rejected) model. The accuracy rate for the transformed model is slightly lower than for the untransformed model. The transformation had negligible impact on the good group prediction rate, but dramatically affected the bad/rejected classification rates. For this one study, it appears that the problem of nonmultivariate normal data can be ignored.

1.2.6. Testing for Significance of Individual Variables

There are no statistical procedures analogous to those used in regression analysis to test for the significance of individual variables. In the linear case, it is possible to test for the conditional significance of individual variables, but such tests are not easy to use. Eisenbeis notes that the coefficients in LDA are not unique and only their ratios are unique, while in regression analysis the coefficients are unique (see also Reichert, Cho and Wagner). Thus, we cannot test if the coefficient of a given variable is zero or any other value. On the other hand, various methods have been proposed to determine the relative importance of individual variables. One method used in some studies is to compare, for each variable, the results of LDA with all n variables against the results of LDA with that variable ignored; this method requires the most work but appears to be Eisenbeis's method of choice (no statistical drawbacks are discussed).

1.2.7. Dimension Reduction

Statistical problems can arise in reducing the number of variables in LDA. Dimension reduction is important in practice, because in credit and other economic problems a large number of variables is often present. There are two chief means of reducing dimension. The first is to compute eigenvectors of the equation $|T - \gamma W| = 0$, where T is the total deviation sums of squares matrix and W is the pooled within-groups deviation of squares matrix. The dimension reducing transformation, using the matrix of eigenvectors, preserves relative Euclidean distance among observations and leaves the significance tests and classification results unaffected. However, this property holds if and only if the group dispersion matrices are equal. The second class of methods determines whether a variable contributes significantly to Wilk's lambda or related statistics used in testing equality of group means. These tests have assumed equal group dispersions.

1.2.8. Truncated Samples

The definitions of good and bad groups are partitions of the general population, whereas credit performance data to compute an LDA rule corresponds to the set of people granted credit. Technically, such a model should not be applied to the entire population but instead should be used for loan review of existing accounts (i.e., for behavior scoring).

This problem is highlighted by Harter (1974), who makes the cogent argument that scoring systems perpetuate an institution's loan policy, because people who never applied for a loan, as well as people who are rejected for credit, are not considered in developing systems to separate good risks from bad. Even if applicant data were available for people who did not apply, we would not know if they are good or bad risks. As mentioned in Gentry, some studies have tried to predict the likely behavior of those rejected. Galitz (1983) and Gentry (1974) also recognize the screening bias. The best credit system would grant credit to every applicant during some time period to gain credit information for the entire population, but few companies do this because the credit loss would be prohibitive. We learned of one mail order company that initially grants everyone a small amount of credit, having found that the resulting sales outweigh the credit losses (Fair Isaac). Also, in the development of a scoring system at Standard Oil, a group of marginal accounts that would have been rejected by human appraisal were granted credit to mitigate this screening problem; however, the group of accounts deemed poor was not granted credit (Klingel and Press 1976).

One way of addressing the problem of the missing data on rejected applicants is to use 3-group discriminant analysis to distinguish the good accepted applicants, the bad accepted applicants, and the rejected applicants. Wagner, Reichert and Cho compared the 3-group model to a 2-group (good/bad) model using data from 405 closed commercial loans and 243 rejected applicants. Using equal group prior probabilities for the models, they concluded that the introduction of the rejected group in the 3-group model did not improve the ability to detect good loans or reduce the number of bad loans predicted to be good. In fact, good/bad classification accuracy (ignoring the rejected) for the 3-group model was 57%, compared with 70.9% for the 2-group model (the total accuracy, for all three groups, for the 3-group model is 70.8%).

If credit is not granted to all applicants, the LDA analysis must be performed with a "truncated" sample. Avery (1977) has shown that this can lead to the

conclusion that the two populations have unequal covariances, even if the covariances of the underlying multivariate normal populations are equal, and hence the conclusion that QDA and not LDA should be used. Also, biased estimates of the cutoff and error rates result. Moreover, even granting credit to every applicant yields a bias, because some people may not be aware of the opportunity to apply or may decide not to apply. Eisenbeis mentions three statistical procedures which may lead to acceptable solutions to this problem: Two are known to yield biased estimates of the predictive ability of the scoring model, while a method by Avery can yield unbiased estimates. Eisenbeis concludes that this area requires additional investigation.

1.3. Case Studies In Discriminant Analysis

In this subsection we discuss several studies that utilize LDA. These studies are representative of the extensive investigation in the 1970s, primarily in universities, into the applicability and effectiveness of LDA. This discussion is intended to provide some insight into the wide range of applications of LDA (e.g., consumer loans, commercial bankruptcy, personal bankruptcy, active versus nonactive bank card holders, bank card profit and charge-off, and second mortgage evaluation), the methodological differences (e.g., LDA versus regression analysis, calculation of the one or two cutoff scores used, and functions of ratios of variables rather than of the variables themselves), and the various conclusions reached. Be warned, however, that sample sizes are small in general, and care should be taken in generalizing the results presented.

The earliest development of scoring rules was due to Durand (1951), who studied good and bad personal loans from commercial banks, finance companies, industrial banking companies, and auto finance companies. The analysis showed that good loans contained higher percentages of borrowers with many years on the job; stability of residence was also associated more with good loans than bad, but the difference was not as great as for employment. Durand found that age, car ownership, marital status, and the number of dependents were not correlated to risk (Savery).

In 1958 William Fair and Earl Isaacs of the Stanford Research Institute developed a scoring system used by American Investment Finance Company and Montgomery Ward (Nelson and Illingworth 1989). Another classic early paper was by Myers and Forgey (1963), who used discriminant and regression analysis to predict credit risk using retail credit application

data. They found that, for the most predictive variables, using equal weights yielded similar results as weights obtained from LDA or multiple regression analysis. This is known as the "flat maximum effect" (see Section 2).

In 1968 Altman published his famous "Z-Score" discriminant analysis model for predicting bankruptcy of commercial firms. His model uses five variables: working capital/total assets ratio, retained earnings/total assets ratio, earnings before interest and taxes/total assets, market value of equity/total liabilities, and sales/total assets. (A discussion of the use of financial ratios in commercial credit decisions is found in Kelley 1986.) The model was over 85% accurate in classifying bankrupt firms one statement prior to failure. Scherr (1982) criticizes Altman's model for not including variables representing firm size, firm age, and economic conditions, stating, e.g., that it is well known that younger firms are more prone to failure. Note that the Z-score model cannot accurately predict the time of bankruptcy, because bankruptcy is a legal term and a company may not be closed down even though it is financially insolvent. The Z-scores of Chrysler and International Harvester, which both experienced financial distress, are discussed in Aspinwall and Eisenbeis (1985). A proprietary refinement of the model, utilizing seven variables (overall profitability, size, debt service, liquidity, cumulative profitability, capitalization, and stability of earnings over 10 years), has been applied to a broader range of companies, including manufacturers, retailers, wholesalers, airlines, and some service firms (Haldeman 1977a, b). However, because of major differences in industry characteristics, it is not applied to financial, real estate, utility, or railroad companies (see also Altman 1986).

Orgler (1970) developed a model for commercial loan review (rather than application scoring). He notes that it is difficult to apply consumer loan methodology to commercial loan review because commercial borrowers are, in comparison, a small heterogeneous group (so gathering sufficient data is hard) with large variation in size, terms, collateral, and payment terms for the loans. Also, accurate current data on small commercial loans, especially those that defaulted, are difficult to obtain. Ideally, individual loan evaluation models should be developed for each industry. (A similar opinion by Scherr is that in forecasting firm failure the models should consider differences between industries, e.g., by using dummy variables or by developing separate models for each industry.) Orgler classifies loans as good or bad, and uses multivariate regression analysis.

Lane (1972) used LDA to study classification of consumers filing under chapter 13 of the Bankruptcy Act, debt counselees (both of whom enter programs for repayment of debt), and personal bankrupts (who do not intend to repay debt). Her model used data on approximately 250 members of each group. Two-group discriminant analysis was used with 17 variables and equal population priors. She found that the Chapter 13 filers and the debt counselees (as a group) could be separated from the personal bankrupts, but that the Chapter 13 filers and the debt counselees could not be separated from each other.

A study by Apilado, Warner and Dauten (1974) of consumer loans from banks and finance companies obtained data on 950 loans; half were paid and half were charged off. Through discriminant analysis their major conclusions are that a small number of variables can be used to construct an effective model (only 10 of the 13 possible variables had an F statistic exceeding two), and risk can be reduced without affecting profitability (one third of all bad loans can be eliminated without eliminating any good loans). They developed both univariate analysis models, which ignored interactions among variables, and multivariate models; the multivariate models, as expected, performed better.

Awh and Waters (1974) used discriminant analysis to see how economic and demographic variables (age, income, education, occupation) and attitudinal variables (attitudes toward credit and bank charge cards, both rated as either -1, 0, or +1) could be used to discriminate between 25 active and 57 nonactive bank card holders.

Fitzpatrick (1976) used regression analysis in an exploratory study of the probable determinants of bank card profit and charge-off rates in 1972. The four dependent variables in the regression equations are net profit rate on average annual cardholder outstandings, net profit rate on gross retail volume, net credit loss on average annual cardholder outstandings, and net fraud on average annual cardholder outstandings. No surrogates for general economic or financial market variables were included, which may increase the variability of the regression equations. Using data from 59 banks, some results obtained are: bank size is a significant determinant of net profit and fraud rates; net profit rates on cardholder outstandings are negatively correlated with bank size (total assets); and increasing bank experience with credit cards decreases credit losses and increases profits.

Long and McConnell (1977) developed a model to evaluate applications for second mortgages using data from 394 loans. A good loan was defined to be one

never more than 30 days delinquent. A loan was bad if any payment was 90 or more days late. Of the 117 variables that were considered, maximum predictive power was obtained using only 9 variables: length of time at current address, largest previous amount of credit, employment classification, if the applicant has a telephone, monthly income less committed payments, and four credit payment experience variables. Unlike the usual case for consumer finance loans, where a cutoff score for granting credit is determined from the costs, a single cutoff is not optimal for second mortgages. Instead, the score is used to determine the amount of the loan (as a function of property value) rather than whether the loan will be granted; details of this method are not given.

Recently, Moses and Liao (1987) developed models for bankruptcy prediction of firms using data on 26 failed and 26 nonfailed small, privately-held government contractors. Using seven financial variables (assets, liabilities, net worth, working capital, sales, earnings before taxes, and earnings before interest and taxes (EBIT)), 21 ratios and their 21 reciprocals could be used. Using textbook stepwise discrimination, they classified 79% correctly. They note that the LDA approach suffers in that the ratios chosen may not be standard financial ratios, ratios selected may be highly correlated, and the ratios chosen may not have any relation to economic theory. (Scherr echoes the concern that the models may bear no relation to theory.) Then factor analysis was used to select four of seven basic independent financial factors and the best of the 21 financial ratios that could represent each factor. The factors and ratios chosen are return on investment (EBIT/sales), leverage (net worth/liabilities), liquidity (working capital/assets), and turnover (assets/sales). However, using DA with these four ratios yielded only 73% success. They note that firms with extreme values for some ratios could introduce errors in LDA. Finally, a novel approach was considered in which firms were rank ordered on a set of ratios and a cutoff maximizing the number of firms correctly classified was determined for each ratio. An optimal cutoff was determined: A firm was classified healthy if at least two of its ratios exceeded the cutoff values for the ratios, otherwise it was classified unhealthy. This approach yielded a 79% classification rate.

1.4. Multiple Discriminant Analysis Models

In applying LDA to a large population, in particular a wide geographic region, it may be desirable to use multiple LDA models. For example, since many people moved to the southern U.S. in recent years, the

variable representing years on the job is less indicative of creditworthiness there than in the northeast. In 1976 Montgomery Ward used 28 different (manual) scoring systems (Paniello 1976), and Sears has 700 different credit scoring models (almost one per store) (Updegrave 1987). The decision to use multiple models must weigh the costs of developing and maintaining the models (a topic we visit only briefly in Section 6) and smaller sample size against the expected benefits.

The only published study concerning multiple models for credit management is by Churchill, Joyce and Channon (1977), who discuss the use of clustering techniques to determine if more than one discriminant analysis model should be built to serve a population.

2. AN EXAMPLE: CITICORP MORTGAGE INC.

This section demonstrates some of the principles described above by discussing some of the credit policies used by Citicorp Mortgage Inc., among the nation's largest (by number of originations, servicing portfolio, or dollar volume) mortgage banks.

Assume that we have an applicant for a \$100,000 mortgage on a home with a purchase price of \$125,000. Assume that the applicant has elected a 30-year Adjustable Rate Mortgage indexed off the one-year Treasury index. The current note rate is 7.5% with an interest margin of 3% (i.e., once a year the note rate will be changed to 3% over the then-current one-year Treasury bill interest rate, unless the adjustment or life cap on the note rate has occurred).

The models discussed below will only be applicable to the class of 20% down, 30-year Adjustable Rate Mortgages indexed off the one-year Treasury index. As Citicorp is such a large originator, we can justify such a specific model.

The first problem is to determine the probabilities p_G and p_B and the associated costs c_G and c_B . From past data we know that about 3% of the loan portfolio goes into default and that 15% of all applicants are turned down. Assuming that a good job is done screening good from bad credit risks, we can guess that two thirds of the 15% turn downs are bad. Consequently, we estimate that

$$p_B = (0.03)(0.85) + 0.10 = 0.1255$$

$$p_G = 1 - 0.1255 = 0.8745.$$

As to the costs for incorrect decisions, we again use past data. To estimate the cost of default we need to add together costs of carrying the home for 3 or 4

months prior to foreclosure (paying taxes and insurance as well as forgoing principal and interest), carrying the home for 3–9 months during foreclosure, repairing the home to make it marketable, and the difference between market price and sale price when sold as a distressed property. Partially offsetting these expenses is the equity (downpayment and principal repayment of the borrower) recovered by the bank. All in all, the average loss for a default on a mortgage with 20% down is 23% of the mortgage. So we estimate $c_B = \$23,000$ in this example.

The cost c_G is the lost opportunity to make additional profit. The profit Citicorp makes is built into the margin they charge over the Treasury index. The 3% margin covers a multitude of expenses: The normal cost of obtaining the funds to lend to the borrower is 0.9% above the Treasury index; the cost of the embedded cap options (the note rate may not go up by more than 2% each year and no more than 6% during the lifetime, no matter how much the index changes); and operating and administrative costs of the firm. Of the interest paid approximately 1% is profit. Thus, the approximate profit the first year is \$1,000. Adding the profit over the lifetime of the mortgage and present valuing of the cash flow, we estimate that $c_G = \$4,000$.

Hence, the cutoff value for the discriminant analysis is

$$\begin{aligned} \ln((c_B/p_B)/(c_G/p_G)) \\ &= \ln((23,000 \cdot 0.1255)/(4000 \cdot 0.8745)) \\ &= \ln(0.8252) \\ &= -0.192. \end{aligned}$$

To perform the discriminant analysis, we consider only two variables: income and years on the job. We need to estimate the mean values for these two variables for the good and bad loans as well as the common covariance. The data from those loans that were accepted will produce biased results, because applicants with low salaries were denied loans. Based on loan officers' opinions, we estimate that: "good" have means of \$36,000 and 2 years; "bad" have means of \$32,500 and 1.5 years; and standard deviations of \$2,000 and 0.2 and correlation of 0.9. Then (1) of subsection 1.1 simplifies to: accept the application if

$$\begin{aligned} L(x) &= 0.000003(\text{income} - 34,250) \\ &\quad + 0.0242(\text{years} - 1.75) > -0.192. \end{aligned}$$

and otherwise reject the application. As an example, if an applicant has an income of \$35,000 and 1 year on the job, $L(35,000, 1) = -0.016$, so the applicant

should be accepted. The values $P(G|I)$ are not estimated and cannot even be guessed.

3. INTEGER PROGRAMMING APPROACH

The second major approach to making yes/no credit decisions on an individual basis is the integer programming approach of Showers and Chakrin (1981) and Kolesar and Showers (1985). They developed a model to determine which AT&T telephone customers should be required to leave a deposit. The advantage of deposits is that they provide protection against bad debt and also serve to deter risky customers; on the other hand, there is a cost of administering a deposit policy and they deter some profitable customers. While they wanted a simple scoring rule, because the customer data were all binary, they felt that classical DA would not be appropriate. They also wanted all weights on the variables to be 0 or 1 for public policy reasons. The binary data yield a finite set of possible customer profiles, and they formulated a 0–1 knapsack problem to determine which profiles should pass. The knapsack constraint is a bound on the probability of misclassifying a good customer. (They discuss other possible objectives and constraints for this decision problem and discuss relationships between the optimal solution set for the different approaches.) They note two drawbacks with this approach: Some profiles have very few people, so the results for these rules may be unreliable, and implementing the rules requires a table lookup which is difficult in practice. An integer program is then proposed which forces the rules to be linear (i.e., accept if $a'x \geq b$). They then require the scoring weights in the integer program to be 0 or 1, which leads to the rule that no deposit is required if the customer "passes" N of the J questions; a nesting property is used to reduce the computation in finding the 0–1 weights by using enumeration. Finally, the authors compare the N of J rules with both the knapsack solution and an LDA package. Applying the rules to a holdout sample, they observe that the knapsack rule does poorly (due to the small samples for some profiles as discussed above), the integer programming rules somewhat better, but both are more sensitive to random fluctuations in sample data than LDA rules. Thus, although the authors originally considered other rules in large part because LDA was felt to be inappropriate for binary data, it outperformed the other methods.

The fact that Kolesar and Showers observed fairly similar behavior for the integer programming and LDA models would seem to lend support to the "flat maximum effect" discussed by Lovie and Lovie

(1986), who observed that in credit scoring different linear models are often indistinguishable in their predictive ability. In particular, a model with unit or equal weights on predictor variables will often perform as well as one with weights obtained from least squares or LDA. This effect was observed in the Myers and Forgy study discussed in subsection 1.3. Lovie and Lovie state that conditions that seem to yield a flat maximum are choosing mainly collinear predictor variables, aligning all predictor variables in the same direction (preferably positively) as the outcome variable, and choosing a binary outcome variable.

4. DECISION TREES

The third major technique for credit decision making is decision trees. Decision trees were developed in the early 1960s by H. Raiffa and his colleagues at the Harvard Business School (Raiffa and Schlaifer 1961). In 1972 David Sparks at the University of Richmond used a decision tree to build a credit scoring model. Decision trees have gained some popularity and received official recognition when the Federal Reserve Board, in its published interpretation of the Equal Credit Opportunity Act, called decision trees an "empirically derived, demonstrably and statistically sound credit system." A detailed mathematical discussion of decision trees is given in Breiman et al. (1984).

A decision tree is illustrated in Figure 3 (taken from Makowski 1985), where the number in each node represents good account probabilities. The root node represents the universe of all accounts under

consideration. Based on the vector x , accounts at a node at level l of the tree are partitioned into two or more nodes at level $l + 1$. The rule used to partition node n_1 at level l may be different from the rule to partition node n_2 at level l . In practice, a single variable is typically used for each branching with the most discriminating variables appearing at the top of the tree and the least discriminating at the leaf nodes. Branching may be done using continuous variables (e.g., income less than or more than \$20,000) or discrete (dichotomous) variables (e.g., owns a home or not). A binary tree with L levels will have at most 2^L leaf nodes.

One way to apply a decision tree is to associate with each node either the probability of nonpayment or the profit for the set of people represented by the node (Makowski). The probability at node n will thus be the weighted average (with the weights determined according to the number of people at a node) of the probabilities of the children of node n . To make a decision on an observation (account), we trace down the tree from the root node, choosing the appropriate branches for the observation, until we reach the proper leaf node; comparing the probability of nonpayment or profit at the node to a chosen cutoff yields the decision.

Mehta (1968, 1970) considers the cost of information in the credit granting decision. The following is our abstraction and generalization of his model. Consider a tree, where a node represents either a state of nature (e.g., high probability of nonpayment) or an "action" (grant credit, deny credit, or investigate

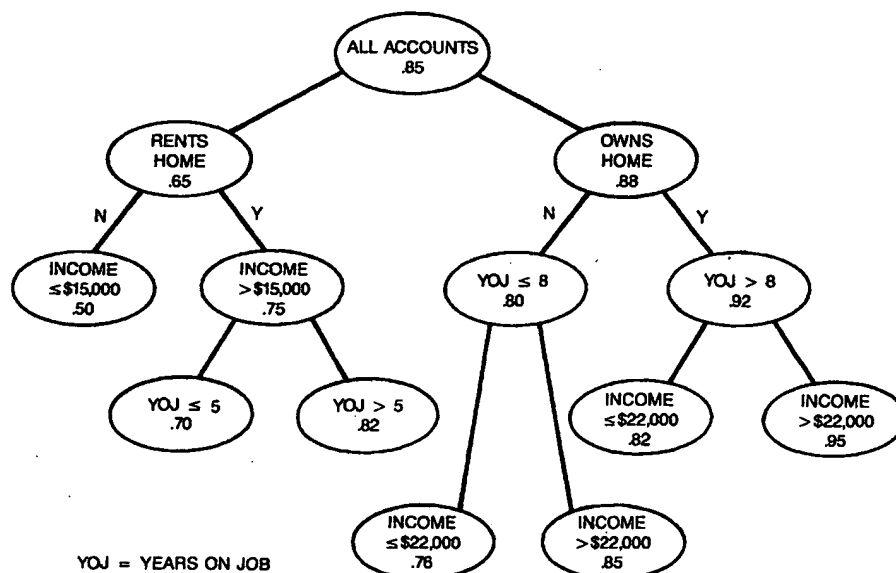


Figure 3. Example decision tree.

further). Each state of nature node always has the three possible action nodes as children. The root node of the tree is defined to be a single state of nature (i.e., a partition with one element). The "grant credit" or "deny credit" action nodes have no children, and the "investigate" node has a set of children representing the possible states of nature for that "investigate" node. Different investigate nodes will, in general, lead to different states of nature. There is a cost associated with each "action" node; this cost is a function of the node and the amount of credit being considered. There is also a probability associated with each state of nature node. We introduce arcs from each "grant credit" or "deny credit" node to an artificial "sink" node. The problem is to find a minimum cost path from source to sink by choosing one of the three action nodes for each possible state of nature node (thus, an action is specified for each possible outcome). Thus, learning more about a potential applicant, by choosing the investigate node, incurs an expense but allows increased revenues (if we learn that the applicant is likely to be good) or reduced losses (if we learn the applicant is likely to be bad). The important point here is that all the possible information on an applicant should not be obtained before making a decision. This notion is analogous to the use of two cutoff scores in LDA: A credit bureau report is obtained only if the score lies between the cutoff values.

The major disadvantage of decision trees is the increased sample sizes needed to obtain statistically sound probability estimates at each node (the nodes at the lowest level have the smallest populations and present the most problem).

The advantages of decision trees are discussed by Makowski. One advantage is that they can reflect the impact of combinations of factors, not just one at a time. In contrast, linear scoring rules consider variables one at a time. He gives as an example the scoring of an applicant for having/not having a credit bureau report, and argues that not having a report is fine for a person who is 20 years old, but is suspicious for a person who is 40. Linear rules would assign a score for the report/no report variable independent of age, while decision trees can contain probabilities for combinations of factors. We have seen that profitability can also be computed using discriminant analysis; the advantage of using decision trees to calculate profitability is that the cost structure can vary from node to node. Other advantages claimed by Makowski, such as ease of use and understanding, are also shared by linear scoring rules and are not compelling arguments for using decision trees.

Coffman (1986) compares decision trees to discriminant analysis. He considers two statistical concepts, intercorrelation and interaction, both of which must be addressed adequately in any sound scoring system (including DA or decision trees). Intercorrelation occurs when some variables x_i and x_j are correlated with each other and also with the quantity of interest (e.g., credit risk). He states that DA is designed specifically to deal with intercorrelation but decision trees, because they do not generally have a node for each possible combination of variables, cannot handle intercorrelation. Interaction occurs when the correlation between some x_i and the quantity of interest (e.g., credit risk) depends on the value of some other variable x_j . When interactions exist among the x_i variables, then their effects are not additive. Coffman then states that tree analysis was designed specifically to handle interactions and can, in fact, be used to test for them. On the other hand, LDA cannot handle interactions unless special variables are included in the model. He states that it is generally much more important to deal adequately with intercorrelation than with interaction, because the former is more prevalent in scoring models. Since LDA deals well with intercorrelation, and decision trees can test for and deal with interactions, both can be used in developing a credit scoring system. These statements are not elaborated on by Coffman.

5. EXPERT SYSTEMS AND NEURAL NETWORKS

The last techniques we mention for making a credit decision for an individual account are expert systems and neural networks.

5.1. Expert Systems

An expert system relies on knowledge and reasoning of human experts to perform a difficult task. Expert systems contain three main components (Nelson and Illingworth): A knowledge base containing all the facts and rules, an inference engine that combines the facts and rules to obtain conclusions, and an interface which allows users to understand the reasoning behind a decision and add or update information on-line. Recently, a number of expert systems have been built to aid in commercial and consumer credit evaluation. For example, Citicorp Mortgage employed a consultant to develop an expert system to do the routine underwriting of loans. Since almost all expert systems allow users to query them about the reasoning used to reach the decision, they can be used to train credit grantors (Zocco 1985, Davis 1987).

At American Express, an expert system called the Authorizer's Assistant was developed to assist in purchase authorization (Davis 1987, Piketty et al. 1987). Each transaction is analyzed by a statistical model to look for charges that fall outside normal patterns. Most charges are normal and approval is automatic. If a charge is abnormal (because of, e.g., payment delinquency, a lost or stolen card, or frequent transactions suggesting fraud) it cannot be automatically approved, and an analysis is required to determine if the person using the card is the true cardholder and if the bill is likely to be paid. To assist in this process, the Inference Corporation built an expert system to advise human authorizers by displaying all relevant information, advising to deny or accept the charge, explaining the advice, suggesting questions to be asked of the cardholder, and suggestions/comments to be noted concerning the account. To build the system, they reviewed hundreds of cases and their resolutions, and interviewed authorizers. Since authorization rules vary somewhat between authorizers, it was necessary to evolve, through discussions, a standard set of rules. The deployable system will contain about 1,500 rules.

LEE (Loan Evaluation Expert) (Bravos 1987) is a knowledge-based system for commercial loan analysis developed at Xerox. LEE works with asset-based lending (also known as collateralized lending), a relatively new service provided by financial institutions which permits customers to apply for a loan on the basis of their assets. LEE works by first identifying the collateral type (usually accounts receivable but also possibly inventory, equipment, plant, etc.). Then the financial status and financial trend of the customer is assessed, yielding a status of good, fair, or poor and a trend of improving, no-change, or deteriorating. In the case of accounts receivable (AR) and deteriorating credit, four variables (quality of AR, recovery potential of AR, control of AR, and source/documentation of AR), whose values depend on the loan application, the customer, and the industry, are used to determine the quality of AR, which is then used to calculate an allowable collateral. In turn this is divided by the requested loan amount to produce the collateral ratio. This ratio is combined with three other variables, and general current economic variables to determine if the collateral is adequate and the loan should be approved, rejected, or further investigated. The number of rules employed, as well as the details of the financial calculations, are not discussed. In 1988 LEE was still in the early stages of testing and evaluation.

5.2. Neural Networks

Neural networks (Gallant 1988, Eberhart and Dobbins 1990, Nelson and Illingworth 1990), which model information processing in the human brain, consist of input, hidden, and output layers of interconnected neurons. Neurons in the one layer are combined according to a set of strengths and fed to the next layer. These strengths allow the network to learn and store associations.

The development of a neural network for credit analysis requires a training stage in which, for example, the network is given actual information about loan defaults and successes along with the support credit application data (i.e., income, occupation, etc.). This information is used to obtain a best set of strengths. Neural networks have been used successfully in corporate credit decisions and in fraud detection; though not yet applied to consumer credit, they are actively being studied and show great promise. Maves (1991) observes that as markets, products, and economics change neural networks can be "re-trained" much more quickly than discriminant analysis-based techniques.

The motivation for using neural networks is that, because DA assumes variables are multivariate normal distributed, when this assumption is not satisfied the results obtained by DA may be erroneous (Wilson and Sharda 1991). Neural networks also are applicable when explicit decision rules are unavailable and information is partially correct (Jensen 1992). Several researchers have compared neural networks to classical techniques.

Dutta and Shekhar (1988) apply neural networks to the problem of bond rating. They review past approaches based on multiple regression and note that they are correct at only about 60% even when as many as 35 financial variables and numerous iterative regressions are considered. They attribute this limited success to the inability to accurately define a mathematical model for bond rating. In contrast, a neural network does not require a model, but rather attempts to learn the underlying model from the raw data. They selected 47 companies at random to study, used 30 of them to train the network, and used the remaining 17 to compare regression and the neural network approach. The success rate during the testing phase for a 2-layer network was 88.3% compared to 64.7% for the regression model. They also observed that adding additional layers to the network decreases the total error in the training phase but has little impact on the testing phase.

Wilson and Sharda compare the success rates of discriminant analysis and neural networks on bankruptcy prediction on 129 firms which were either in operation or went bankrupt between 1975 and 1982. Commercial PC-based statistical packages were used for both DA and neural networks. To achieve a better measure of predictive accuracy, they used Monte Carlo resampling techniques to generate multiple subsamples, where each subsample consisted of a training and a testing set. They used the same five financial ratios as Altman (1968) and used five input neurons (one for each ratio), ten hidden neurons in the hidden layer, and two output neurons (one indicating bankrupt, the other indicating nonbankrupt). They trained the network until all firms in the training set were classified correctly (this was possible in all 180 subsamples generated). The percentage of successes depend on the fractions f_1 and f_2 of bankrupt cases in the training and testing sets; when $f_1 = f_2 = 0.5$, the neural networks correctly classified 97% compared to 88% for DA. Neural networks outperformed DA for every value of f_1 and f_2 studied. The greatest improvement was in the classification of bankrupt firms; the authors note that this is important because it is widely accepted that it is more costly to classify a failed firm as nonfailing than the converse. The authors also survey several financial applications of neural networks (e.g., in rating corporate bonds, credit card fraud, and commodity trading).

Jensen mentions two recent studies on how neural networks might be applied to credit granting; unfortunately, neither study presented any statistics on classification accuracy. He then uses commercial PC-based neural network software to analyze data on 125 loan applicants, whose loans were classified as delinquent, charged-off, or paid-up. Since the delinquency rate is only 9.6% and the charged-off rate is 11.2%, there is insufficient data to apply credit scoring. The network has 24 input neurons, two hidden layers with 14 neurons each, and three output neurons. The network misclassified 16% of the applications as good when they were bad and 4% as bad when they were good. In comparison, a credit scoring model misclassified 8% as good when they were bad and 18% as bad when they were good.

6. DYNAMIC MODELS

Almost all credit decisions are dynamic and not single period. This is clearly true for consumer retail or bank credit cards, for both revolving or nonrevolving credit. It is also true for both commercial and consumer loans that are paid in installments. Finally,

even loans to be paid back in full at a specified time become dynamic if the debtor defaults and collections extend over time. Surprisingly, there is scant published literature treating the dynamic credit problem, and this literature is in the academic realm. Judging from the published literature, dynamic models have had considerably less impact in practice than static models. In this section we consider the use of Markov chains for projecting account behavior into the future, acceptance and credit limit decisions, and start treatment level and collections decisions. Such "flow modeling" is routinely used by collection managers even though many have never heard of a Markov process.

6.1. Account Aging and Markov Chains

In 1962 Cyert, Davidson and Thompson (1962) used techniques of Markov chains to study the long-term, expected uncollectible amount in each age category. Here age means how long past due is the account. Define B_j as the amount j periods (e.g., months) past due at some period for $j = 0, 1, 2, \dots, J$. Here j is the state variable, $j = 0$ represents the paid in full state, and $j = J$ represents those accounts J or more periods past due and is the bad debt state. Let B_{ij} be the amount in state j in some period which came from state i in the previous period. Both B_i and B_{ij} are assumed stationary or time-independent. Then the transition probability P_{ij} of a dollar in state i at some period transiting to state j in the next period is given by

$$P_{ij} = \frac{B_{ij}}{\sum_{m=0}^J B_{im}}.$$

The states $j = 0$ and $j = J$ are absorbing states: $P_{0,m} = 0$ and $P_{J,m} = 0$ for all m . The authors note that there are two methods available for aging: In the total balance method, all dollars in the account are put in the age category corresponding to the oldest dollars, and in the partial balance method, the dollar balance is allocated among the age categories on the basis of the age of each dollar in the account.

Reorder the states so that the absorbing states 0 and J come first, and then the other states 1, 2, ..., $J - 1$. Partition P into the form

$$P = \begin{pmatrix} I & 0 \\ R & Q \end{pmatrix},$$

where I is the 2 by 2 identity matrix. Let $N \equiv (I - Q)^{-1} = I + Q + Q^2 + \dots$. Then the entries of

the $(J - 1)$ by 2 matrix NR give the probabilities of absorption in each of the absorbing states 0 and J .

Now let S_0 be the vector whose j th component is the initial amount in the j th age category $j = 1, 2, \dots, J - 1$. Then $S_t = S_0 Q^t$ is the vector whose j th component is the amount outstanding for the j th age category at the beginning of the t th period for $t = 1, 2, \dots$. The vector $S_0 NR$ (with two components) is the expected payment and bad debt from the accounts receivable (the authors provide a formula for the variance).

We can generalize this model to include installment loans. As above, let $j = 0$ represent the paid in full state. Let state $j = 1$ represent the current state, i.e., those who are up to date in payments. Let states $j = 2, \dots, J - 1$ be the states of payment 1, 2, \dots , $J - 2$ periods in arrears. Finally, state $j = J$ is default. For monthly payments of \$1, moving from state i to state j involves payment of $i - j + 1$ dollars for $1 \leq i, j \leq J - 1$. This may be written as a matrix M :

$$M = \begin{pmatrix} 1 & 0 & \cdot & 0 \\ 2 & 1 & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot \\ J-1 & J-2 & \cdot & 1 \end{pmatrix}.$$

Let T_t be the multiplication of M with Q_t , element by element (e.g., $T_{ij} = M_{ij} Q_{tj}$). Then T_t represents the expected received payments in the sense that $S_0 T_t$ is the vector of expected payments from states 1, 2, \dots , $J - 1$ (excepting last payments and prepayments) at time t and $S_0 T_t e$ (where e is the $J - 1$ column vector with all entries 1) gives the total expected payments.

The Cyert-Davidson-Thompson model assumes the total balance method of account aging in which the age of an account is the age of the oldest unpaid dollar in the account. Thus, for example, if at some time a bill for \$20 is one month past due and a bill for \$10 is two months past due, the method assumes that \$30 are two months past due. The problem with this method is that if a payment of \$10 is made, the method then indicates that \$20 are two months past due, whereas if we assume the payment applies to the oldest dollar, then we actually have \$20 only one month past due. The steady-state distributions computed using total balance aging tend to underestimate the actually paid dollars. Van Kuelen, Spronk and Corcoran (1981) present a simple modification of the CDT method to make the accounting more realistic.

Corcoran (1978) notes that the transition matrices in the CDT model can become unstable, and stability can be enhanced if accounts were first grouped according to size and then a transition matrix computed

for each group; otherwise if large and small accounts were mixed, a large payment would drastically affect the transition probabilities. Corcoran modifies the CDT model to use the partial balance method of aging, and uses the data to compute the monthly transition matrices, which are weighted to arrive at an average or exponentially smoothed matrix. When applied to the aging data for a month, this average matrix yields the estimated data for the next month. This modification avoids the stationarity assumption in the CDT model: See Frydman, Kallberg and Kao (1985) and Mehta (1970) for other extensions of the CDT model.

6.2. Acceptance and Credit Limit Decisions

The first dynamic model for determining credit acceptance or a credit line appears to be by Bierman and Hausman (1970) who consider the question of whether or not to grant credit. They provide the following insightful example of why it is necessary to consider multiple time periods. Consider a product that costs $c = 62$ to produce and sells for $s = 100$. We will consider granting credit as long as the expected k period return is positive.

First, for $k = 1$ let p be the probability that the item, when sold on credit, is paid for in full. If $p = 3/5$, then the expected profit from period 1 to the end of the horizon (period 1 in this case) is $(3/5)(100 - 62) + (2/5)(-62) = -2$, so credit should not be offered in period 1.

Now assume that there is a prior probability distribution on the probability of collection. This Bayesian approach assumes that the credit grantor's prior feelings about the probability of payment can be represented by letting p be a random variable with a Beta distribution with parameters r and n (the expected value is r/n). Suppose that credit is extended n' times and full payment is made r' times. Then the parameters of the Beta distribution are revised according to: $r \leftarrow r + r'$ and $n \leftarrow n + n'$. The new distribution is called the posterior distribution.

Suppose that the parameters of the prior are $r = 3$ and $n = 5$. As shown above, the expected 1-period revenue is -2 , so we would not extend credit. Now consider two periods ($k = 2$). With probability $2/5$ the customer defaults in period 1, in which case he defaults in period two with posterior probability $3/6$. Thus, the expected profit in period 2 is $(3/6)(100 - 62) + (3/6)(-62) = -12$. Since the expected profit from period 2 to the end of the horizon (period 2 in this case) is negative, credit for a defaulted customer should not be granted for period 2. With probability $3/5$ the customer pays in period 1, in which case he

pays in period 2 with posterior probability $4/6$. Thus, the expected profit in period 2 is $(4/6)(100 - 62) + (2/6)(-62) = 4.67$. Since this is positive, credit would be granted for a paying customer. Putting this all together, the expected 2-period profit is $(3/5)[(100 - 62) + 4.67] + (2/5)(-62 + 0) = 0.8$. Thus, the expected gain from two periods is positive, so we should offer credit initially.

Bierman and Hausman indicate that determining the prior distribution parameters r and n may not be easy, and that the expected k period profits will, in general, vary with r and n , even if their ratio (the mean of the distribution) remains constant.

We now present Bierman and Hausman's dynamic programming formulation of the multiperiod credit granting problem. Let c_1 be the single period profit if credit is given and payment is made, c_2 be the single period loss if credit is given and no payment is made, (r, n) be the state variable, where r and n are the parameters of the current prior Beta distribution on the probability of payment, $f_i(r, n)$ be the maximum expected discounted payoff from stage i to ∞ given that the current stage is (r, n) , $d_i(r, n)$ be the optimal action at stage i , where $d_i(r, n) = 1$ means grant credit and $d_i(r, n) = 0$ means deny credit, and α be the discount rate. Then we have

$$\begin{aligned} f_i(r, n) \\ = \max \{ (r/n)(c_1 + \alpha f_{i+1}(r+1, n+1)) \\ + (1 - (r/n))(c_2 + \alpha f_{i+1}(r, n+1)); 0 \}. \end{aligned}$$

The term to the left of the semicolon in the "max" expression is the expected profit if credit is granted, and the 0 represents the expected profit if no credit is granted. Here r/n is the expected probability of payment in the current period. If payment is made, the state (r, n) is updated to $(r+1, n+1)$; if no payment is made the state is updated to $(r, n+1)$.

Bierman and Hausman also consider the dynamic problem of how much credit to grant (i.e., setting the credit line). They assume that, if an amount y of credit is extended in the start of a period, the probability of collection (payment in full) at the end of the period is p^y , where p is the probability of payment in full for a unit of credit. (Partial payments are not considered.) The prior density function of collection is also assumed to be a Beta distribution with parameters r and n and is updated by setting $(r, n) \leftarrow (r+y, n+y)$ if y is extended and collected. Since the updating of the prior turns out to be complicated if collection is not made, they assume that the expected discounted payoff after a period of no collection will be zero.

Since $(r/n)^y = [E(p)]^y$, with the previous notation, we now have

$$\begin{aligned} f_i(r, n) = \max_{0 \leq y < \infty} \{ (r/n)^y [c_1 y + \alpha f_{i+1}(r+y, n+y)] \\ + [1 - (r/n)^y] c_2 y \}. \end{aligned}$$

The Bierman-Hausman model has been extended by Dirickx and Wakeman (1976) and Srinivasan and Kim (1987). The major result of Dirickx and Wakeman is that it is not necessary to assume that the expected future payoff from period i on is 0 if no collection is made; although Beta distributions are no longer always preserved, the computations can still be performed. Srinivasan and Kim make a simple modification relaxing the implicit assumption in the Bierman-Hausman model that the credit grantor simultaneously makes collections and extends credit; a simple timing modification is presented.

6.3. Start Treatment Level and Collection Decisions

Mitchner and Peterson (1957) consider the problem of how long to continue to pursue collections for a defaulted loan. The problem is the tradeoff of collections cost against the expected recovery if collections activities are continued. They compare the results of the optimization to historical data and observe that use of the optimal strategy would lead to premature abandonment of only a small number of loans that actually converted to paying status; similarly, use of the strategy would lead to early abandonment of many loans that did not convert to paying status.

Their model assumes a cost c of collections pursuit per loan-month, and a probability $p(t|t_0)dt$ that a loan converts between times t and $t + \delta t$ given that the loan has remained nonpaying for time t_0 . Thus, the probability that a new loan will convert between t and $t + \delta t$ is $p(t|0)dt$, and infinite pursuit of a loan yields a probability $\int_0^\infty p(u|0) du$ of eventual conversion. Let z be the average fraction of the recovery when collections yields a payment, and let A be the amount owed. Then the optimal amount of time T to pursue a loan satisfies $p(T|T) = c/(zA)$, and the maximum expected profit for a loan of age t_0 is

$$\begin{aligned} N(T|t_0) = \int_{t_0}^T [zA - c(u - t_0)] p(u|t_0) du \\ - c(T - t_0) \left[1 - \int_{t_0}^T p(u|t_0) du \right]. \end{aligned}$$

The authors discuss the use of maximum likelihood estimation to estimate the probability of conversion

$p(t|0)$ for a new loan. They also provide a simple heuristic method for estimating the probabilities and show that the heuristic and MLE estimators are equal if the fraction of loans of age t that convert or close-out in r time units is independent of t .

Liebman (1972) developed an infinite-horizon Markov chain model to determine the optimal collections strategies. (Liebman considers the strategies of no action, a letter requesting payment, and a telephone call.) Accounts are divided into subpopulations, depending upon such variables as age, past payment experience, and past and current activity. Let $P_{ikm,jln}^s(c_{ikm,jln}^s)$ be the probability (cost resulting from) of an account moving from age class i , charge volume class k and previous experience class m to age class j , charge volume class l and previous experience class n in one time period when strategy s is used. Drawing upon the results of Howard (1960), the optimal policy with t periods left in the planning horizon satisfies

$$v_{ikm}(t) = \min_s \left\{ \sum_{jln} P_{ikm,jln}^s [c_{ikm,jln}^s + \beta v_{jln}(t-1)] \right\},$$

where beta is the discount rate and $v_{jln}(t)$ is the minimum expected total cost with t stages left starting in state jln . This can be solved using policy iteration (Howard), which consists of solving a set of linear equations and making a series of comparisons.

Liebman also shows that determining the optimal policy can be formulated as a linear program: Let x_{ikm}^s be the steady-state probability that the system is in age class i , charge volume k , previous experience class m and s is selected. The LP is

$$\text{minimize } \sum_{ikms} x_{ikm}^s \sum_{jln} P_{ikm,jln}^s c_{ikm,jln}^s$$

subject to

$$\sum_{ikms} x_{ikm}^s (\delta_{ikm,jln} - \beta P_{ikm,jln}^s) = (1 - \beta)/t \quad \text{all } j, l, n$$

$$\sum_{ikms} x_{ikm}^s = 1, \quad x_{ikm}^s \geq 0.$$

The linear program has the advantage over policy iteration by providing sensitivity analysis of the optimal policy to changes in the costs and transition probabilities.

Pye and Tezel (1974) present a dynamic programming approach to determine the value of a collateralized loan subject to default. Let a series of equal payments be scheduled for the next T periods. Without loss of generality, we can assume that each payment is \$1. A payment not received at the end of the scheduled period is one period late, and a foreclosure decision is made. If the payment is two periods late,

another foreclosure decision is made; this continues until foreclosure or full payment is received.

To formulate the model, let n be the number of periods that payment is late, and let $V_t(n)$ be the maximum expected present value of loan payments subsequent to t , given that an optimal foreclosure policy is used and the payment scheduled for period t is n periods late. If the payment n periods late is received in period t , a new loan terminating at time T is negotiated, with an expected present value of $n + 1 + V_t(0)$. If foreclosure occurs in period t , the lender receives collateral with an expected present value of b_t , plus a "deficiency judgment" on back payments with expected present value $\xi_n n$. We assume that $b_t \leq 1 + V_t(0)$ for all t , which means that the value of the collateral does not exceed the value of the loan when payments are on time (otherwise the borrower should sell the collateral). The probability of receiving payment in the next period when payment is currently n periods late is γ_n . The present value this period of a dollar received in the next period is denoted by α .

The dynamic programming recursion is then

$$V_t(n) = \alpha \gamma_n (n + 1 + V_{t+1}(0)) + (\alpha - \alpha \gamma_n)$$

$$\cdot \max \{b_{t+1} + \xi_{n+1}(n + 1), V_{t+1}(n + 1)\},$$

$$V_T(n) = \alpha \gamma_n n + (\alpha - \alpha \gamma_n) b_{T+1}.$$

These equations are derived as follows: Given n and no foreclosure in period t , in the next period either payment is received with an expected value of $n + 1 + V_{t+1}(0)$ or payment is not received, in which case the lender can foreclose and receive $b_{t+1} + \xi_{n+1}(n + 1)$, or not foreclose and receive $V_{t+1}(n + 1)$. By working backwards from the horizon, the value of a collateralized loan is $V_0(0)$.

Pye and Tezel consider the special case in which $b_t - b_{t+1} = \lambda > 0$ for all t (the unearned premium decreases by a constant amount each month), $b_{T+1} = 0$ (the payments are completed when the value of the unearned premium is zero), and $\xi_n = 0$ (no collection of defaulted payment upon foreclosure). In this case, they derive the closed-form solution for $V_t(0)$ and a constant v^* such that foreclosure is always optimal when $n = 1$ (whenever a payment is one period late) for any t if and only if $v_1 \leq v^*$.

7. CREDIT SCORING IN PRACTICE

Credit scoring is gaining acceptance: A 1990 survey reported that 82% of banks using expert systems employ credit scoring for commercial, consumer, and mortgage loans, even though the cost of developing a credit scoring model is estimated to be \$50,000–

OWN/RENT	OWNS 45	RENTS 18	ALL OTHER 24			
YEARS WITH EMPLOYER	UNDER 1 YEAR 15	1 TO 2 YEARS 22	3 TO 4 YEARS 26	5 TO 9 YEARS 26	10 TO 12 YEARS 29	13 YEARS & OVER 36
CREDIT CARD	CARD 19	NO CARD 0				
FINANCE COMPANY	YES 0	NO 38				
BANK ACCOUNT	CURRENT +DEPOSIT 50	CURRENT 31	DEPOSIT 32	NONE GIVEN 15		
OCCUPATION	PROFESSIONAL/ EXECUTIVE 29	MANAGER/ SEMI-PROFES- SIONAL 28	OFFICE STAFF 25	PRODUCTION 15	SALES 22	ALL OTHER 15
PREVIOUS ACCOUNT	UNSATISFACTORY 0	NEW 55	SATISFACTORY 87			
CREDIT BUREAU	NO FILE 15	DEROGATORY RATINGS -33	1 OR 2 SATISFAC- TORY RATINGS 24	3 SATISFACTORY RATINGS & UP 30		

Figure 4. Example scoreboard.

\$100,000 (Jensen). This section discusses the practical aspects of credit scoring, including development of a system, studies comparing human experts to credit scoring, validating the system, sources of data, and legal considerations.

7.1. Development

Consumer scoring development typically begins with tests of 60–80 questions that are narrowed down to the 9 or 12 questions that prove to be the best predictors (Main 1977). An example of an LDA rule for credit scoring (known as a "scorecard") is shown in Figure 4 (taken from Fair Isaac). In consumer scoring, a minimum of approximately 300 bad accounts is needed for statistically significant results (Chandler

1985); having enough good or rejected accounts is not generally a problem. (As noted above, data can be scarce for commercial credit scoring.) Scorecards can be used for both applicant scoring and behavior scoring. Figure 5 (taken from Fair Isaac) illustrates scoring for credit limit adjustment.

In implementing a scoring system, questions may be asked and not scored, and the items which are scored and their weights may not be available to the scorers to reduce the vulnerability to fraud (Day). The questions not scored provide demographic data valuable for financial and marketing purposes.

Some interesting clues to scoring systems are provided by Updegrave. A perfect history of bill payments can yield 25% or more of the points needed for

ACTIONS: ○ = NO CHANGE TO LIMIT
+ = INCREASE LIMIT
- = DECREASE LIMIT

ACCOUNT STATUS SCORE	CURRENT			30 DAYS PAST DUE		
	<75% OF LIMIT	75 TO 100 % OF LIMIT	>100% OF LIMIT	<75% OF LIMIT	75 TO 100% OF LIMIT	>100% OF LIMIT
BELOW 500	○	○	○	-	-	-
500-599	○	+	○	○	○	○
600 & UP	○	+	+	○	+	+

Figure 5. Using performance score for credit limit adjustment.

approval. Bank credit card delinquencies hurt more than retail card delinquencies. Lenders ignore some derogatory entries, such as small unpaid medical bills, because they usually indicate a dispute over the bill. However, personal bankruptcy usually spells definite rejection. Typically, a monthly income of \$1,500 might earn 10 points, \$2,500 monthly earns 12 points, and no additional points are earned after \$3,000 monthly. Some scoring systems place applicants into one of 8 job categories: professional, managerial, blue collar supervisor, clerical, sales, self-employed, skilled trade, and unskilled worker. Executives and professionals typically earn the most points (about 30), while unskilled workers may earn only 5 (this contradicts Savery).

Sears has found that occupation has no predictive value among its customers (Main), and keeps its losses below 1% by using a high cutoff score. Diner's Club also has high standards and fails about 50% of its applicants. A store with a high profit margin, and thus an ability to withstand heavy losses, might fail only 10%. In today's competitive environment, a bank typically fails only 20–40%. Gist reports that credit management needs careful attention: one San Diego bank offered preapproved credit cards to people who were unemployed or even dead (then lost \$63 million and sold its credit card business). Lastly, Anonymous (1986) gives a frightening story (from a creditor's point of view) of the fraudulent acquisition and use of 32 credit cards; the moral of this tale is that ideally all the information on credit applications should be verified; however, this is generally prohibitively expensive in practice.

Gist provides other data on bank card credit operations: one estimate is that a new portfolio of bank credit card users takes from 1–2 years to mature and that losses of 4%–5% can be expected during that time, especially if direct mail solicitation is used; upon maturity, losses of 2–3% can be expected.

We now review the relatively scant literature on the use of behavior scoring (i.e., existing account management). Connors (1988) and Coffman and Darsie (1986) discuss how a collection strategy can be determined using a behavior score. Each range of behavior scores can be assigned to a collection strategy, defined as a sequence of collection actions. The strategy would specify the action to be taken each month if no payment is received.

Behavior scoring is very effective when used in conjunction with experiments to determine the best action (Weingartner 1966, Klingel and Press 1976, Kaye 1981, Coffman 1986). For instance, to test the effectiveness of collection actions, accounts can be

split into groups, with a different range of behavior scores for the accounts in each group. Each group is then subdivided into subgroups with a different action assigned to each subgroup. After a period of, say six months, the accounts are examined to determine the effectiveness of each action. By examining the cost/benefit of each action, the best strategy can be identified for each range of behavior scores. Connors notes that continuous testing of alternative strategies allows pro-active credit management, rather than reacting based on signs of deterioration of the scoring system.

A variety of credit systems can be purchased which may offer features beyond credit analysis such as the ability to automatically generate denial letters, obtain credit reports, set up accounts on the credit grantor's mainframe, and integrate with card embossing systems. Since banks may receive as many as 21,000 credit card applications per month, automated systems can considerably reduce costs. A survey of such systems is provided by Cohen (1985).

7.2. Subjective Versus Empirical Scoring

Several early studies pointed to the fallibility of human judgment making in scoring. Gentry mentions a 1964 study in which, of 17 variables, only the interviewers appraisal did not significantly discriminate between the goods and bads. Also, a 1972 study indicated that when credit managers approved people with low scores, this group became the highest delinquency group. Sears studied what happened when credit managers approved a loan that the scoring system rejected and found that 95% of the loans were hard or impossible to collect (Main). A Fair, Isaac Companies survey found that 22% of users stated that loans scoring below the cutoff were never approved; the rest allow human override. Also, 44% of the companies surveyed tracked the performance of those approved due to human override: Of these companies, 84% rated the accounts as unsatisfactory (Nelson). Chandler and Coffman discuss an experiment in which 25 good and 25 bad accounts were scored by a model and a group of experienced analysts. When the cutoff was set to approve only 25 accounts the model made 4 errors (4 known bad accounts were accepted). When the analysts were asked to approve the best 25, only one analyst did as well. Finally, prior to their development of scoring rules to determine deposit policies for residential telephone users, public utility commissions viewed judgmental screening (then in effect) as neither uniform or objective, and not effective in identifying the nonpaying

customer with a reasonable degree of accuracy (Showers and Chakrin).

The above data suggest that a good scoring system outperforms human experts. If true, since expert systems are intended to mimic human experts, the recent interest in expert systems should be confined to those credit management decisions not amenable to empirical methods. For example, fraud detection, but not consumer or commercial loan evaluation, is probably best performed with an expert system.

Not everyone extolls the advent of scoring systems: Harter (1974) claims that scoring systems represent a composite of the loan officer's judgments and loan officers must continue to use their judgments to pre-screen applicants before using a scoring system. Harter then claims that "it is unlikely that credit scoring systems will become widely adopted ..." and "... will be relegated to the academic world and regulatory agencies ..." (so much for predictions). Hall (1983) discusses the different effectiveness of closed questioning, in which the applicant selects from a set of alternatives or responds to a specific question (the method used by scoring systems), versus open questioning, in which the applicant has a conversation with the credit grantor.

7.3. Validating the Scoring System

An important practical issue is whether existing scoring formulas continue to be effective as economic conditions or the stream of applicants change (Klingel and Press). For example, people today often possess many more bank credit cards than previously. Another example is that, for professionals, the length of time on a job or at a residence may be poor predictors of risk. If changes are necessary, then the entire model and not just the point values need to be updated as new data become important.

Long (1976) developed a model to determine the optimal schedule for updating a scoring system. The time between updatings is shown to be a decreasing function of the decay (performance) rate and the growth rate of good and bad accounts, and an increasing function of the cost of updating the system and the discount rate. Long also discusses a method for determining the decay function (e.g., $f(t) = 1 - \alpha t$ or $f(t) = 1 - \alpha t^2$ for some parameter α), using data on the performance of the system over time.

A survey by Fair, Isaac (Nelson) indicated that only 16% of the companies surveyed had credit scoring development dates before 1979, and 44% reported validations during 1980-1981. Sears, with 60 million cardholders and 700 different credit scoring models (almost one per store), updates scoring systems every

three years (Updegrave). Of the 61% who reported a problem during installation and operation of the systems, difficulty in tracking system performance was identified as a major concern: Only 22% of the companies surveyed are able to track, by score and time on the books, good accounts versus delinquents.

7.4. Sources of Credit Information

The chief source of consumer credit information is the three U.S. credit bureaus that serve a wide geographic area with their own computer data base containing accounts receivable information from credit grantors and public record information. The data bases are vast: TRW estimates it has information on 133 million consumers. The bureaus obtain ledger information from credit grantors, verify employment with employers, and obtain credit-related public records (such as bankruptcy, lawsuit, judgment, or divorce data). The standard format of a credit report contains information on who is responsible for paying the account, the type of business reporting the information, the date of the information (major creditors send updated information monthly), the date the account was opened, the date of the last payment, the highest amount of credit extended, whether the account is open charge, revolving, or installment, explanatory remarks (e.g., dispute following resolution, dispute pending resolution, moved with no forwarding address, repossession, card stolen or lost). People or firms with a legitimate need for credit reports can purchase them from the credit bureaus; the Fair Credit Reporting Act lists permissible purposes for obtaining consumer credit reports. When joining a bureau, a credit grantor usually agrees to supply a list of its current customers and their payment histories.

In accordance with antidiscrimination laws, retailers can supply a bureau with requirements such as income or time on job, and receive a list of potential new customers. Bureaus also may provide computerized lists of people with good payment records; these lists may be purchased by retailers for solicitation purposes. Credit bureaus often offer a retail debt collection service. Consumer rights with respect to credit bureaus are discussed in Criscuoli (1985) and Cole (1988).

Bureaus also offer commercial credit data including current and previous payment information, payment trends, industry payment profiles, public record information, financial information from Standard and Poors, basic company data (e.g., sales, number of employees), and information on debt to government agencies.

In addition to general credit information on consumers, credit bureaus also maintain national lists of delinquents. One such list has data on 10 million people (Hicks 1975). Derogatory information is kept for five years, and the data are updated about twice monthly. Credit card companies and other firms can submit lists of names to determine delinquencies, at a nominal cost per inquiry. Such a process is called prescreening. For example, the Associated Credit Services allow a financial institution to choose from a variety of "standard" prescreening criteria; ACS then selects, from its 80 million names, individuals who match the requirements. Typical requirements are no bad debts, no suits or judgments against the individual, the individual has good standing with other creditors, and the individual has a job. A variety of prescreening options are discussed by Jarvis (1986).

Names to solicit for new accounts can be obtained from a variety of sources, including recent utility turn-ons (Kane 1982). The Claritas Company provides demographic information on neighborhoods within a zip code, describing neighborhoods by their reaction to promotions and presumed payment characteristics (Rossi 1982).

7.5. Legal Considerations

We mention lastly the complicated and important area of credit scoring systems and laws prohibiting discrimination. The key pieces of legislation are the 1974 Equal Credit Opportunity Act (ECOA) which prohibited discrimination in the granting of credit on the basis of sex or marital status and the implementation of the act through the Federal Reserve Regulation B; and the Amendments of March 1976 that additionally prohibited discrimination on the basis of race, color, religion, national origin, age, receipt of public assistance benefits, and the good faith exercise of rights under the Consumer Credit Protection Act. Regulation B describes criteria that scoring systems must satisfy to ensure they are methodologically and statistically sound. Three criteria are specified (Wagner, Reichert and Cho): the credit data for system development should be either the institution's entire population or a properly drawn sample with both accepted and rejected applicants; prior to implementation, the system must be validated using actual data to ensure that it can distinguish creditworthy from noncreditworthy applicants in a statistically significant manner (no specific statistical test or level of significance is mandated); the system must be periodically revalidated at appropriate time intervals (no interval is mandated).

The subject of credit scoring and discrimination law is well beyond the scope of this survey; for additional information the reader may consult Galitz, and a very detailed and careful analysis in the Yale Law Journal (Anonymous 1979) replete with additional references.

8. AN EXAMPLE: CITICORP MORTGAGE INC.

Continuing the example of Section 2, we can also look at the loan portfolio as it ages and estimate the transition probabilities for the Markov chain approach. We have these states:

- state 0: paid off either by prepaying or coming to full term;
- state 1: owes the current month;
- state 2: one month in arrears;
- state 3: two months in arrears;
- state 4: three months in arrears;
- state 5: in default.

For our assumed 20% down typical adjustable rate mortgage borrower, we estimate the transition matrix P to be

$$P = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0.01 & 0 & 0.9625 & 0.0275 & 0 & 0 \\ 0.01 & 0 & 0.9 & 0.05 & 0.04 & 0 \\ 0.001 & 0 & 0.649 & 0 & 0.05 & 0.3 \\ 0 & 0.85 & 0.13 & 0 & 0 & 0.02 \end{pmatrix}$$

Then

$$NR = \begin{pmatrix} 0.97 & 0.03 \\ 0.96 & 0.04 \\ 0.70 & 0.30 \\ 0.13 & 0.87 \end{pmatrix}$$

Thus, 3% of an initial portfolio will default. The eventual defaults among those in arrears one month is only 4%; the percentage jumps to 30% of those 60 days in arrears. Once a borrower reaches 90 days in arrears, the likelihood of an eventual default is overwhelming (87%).

9. CONCLUDING REMARKS

The 1960s saw the limited use of discriminant analysis in credit scoring, as well as the development of many of the classic multiperiod methods, such as the Cyert-Davidson-Thompson Markov chains model and the Bierman-Hausman dynamic programming approach. The 1970s was a period of widespread experimentation with scoring, and a deeper understanding of the statistical issues involved, as well as refinements on the multiperiod methods. The 1980s have seen limited theoretical progress on both discriminant

analysis or multiperiod methods. Instead, the major themes of the 1980s have been expert systems, multiple scorecards (or, in the "limit" decision tree approaches), and the use of experimental strategies to determine optimal policies.

By far the most mature branch of quantitative methods is in deciding whether to accept or reject a credit applicant (or in loan review). The use of statistical methods and experiments to determine optimal start treatment levels and collections strategies is less well established, and is much more of an art. While Markov chain transition matrices have been used in these methods, the more sophisticated techniques of linear or dynamic programming appear to be unused in practice. For many of the other important credit decisions, such as adjustment of the credit limit, reissue period, and promotions strategy, there is no published evidence of quantitative methods in use and little theory: Only the Bierman-Hausman model (and its refinements) consider the credit limit, and no theory exists for the reissue period and promotional strategies.

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Bank Heterogeneity, Reputation and Debt Renegotiation

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**BANK HETEROGENEITY, REPUTATION AND DEBT
RENEGOTIATION***

BY RAQUEL FERNANDEZ AND DAVID KAARET¹

This paper examines a process of debt renegotiation in which banks possess divergent interests and there is asymmetric information. We assume that large banks must exert pressure on small banks in order to obtain participation of these in the provision of new money and in debt forgiveness. Making use of a reputational model, we argue that the effect of asymmetric information as to the amount of pressure that large banks can exert on small banks makes the debtor countries worse off than absent these asymmetries in information. This also provides a rationale for the growing popularity of exit bonds.

1. INTRODUCTION

The failure of several LDC's to meet the original payment schedule on their loans from foreign banks ushered in the "debt crisis" at the beginning of the 1980's. Since then various theories have been proposed to explain the causes of this crisis. These theories have stressed alternatively the macroeconomic shocks faced by LDC's (as a consequence of a U.S. economic policy after the second oil shock that resulted in high real interest rates, a world wide recession, and unfavorable terms of trade), the failure of LDC governments to adjust to the new economic environment, and the existence of market imperfections (resulting, for example, from collective action problems within syndicates and the threat of default).²

The problems and the factors that influence the renegotiation process, however, have received far less theoretical attention. A few exceptions are Caskey (1989), Sachs (1983), Krugman (1985), Bulow and Rogoff (1989a), Fernandez and Rosenthal (1990), and Fernandez and Glazer (1989, 1990).

Sachs shows that if banks possess an increasing marginal cost of loans and if each bank negotiates separately with the debtor country, default is a possible competitive equilibrium when the country faces a temporary liquidity crisis although the country is not insolvent. This occurs because it may not be in the interest of any individual bank to extend a further loan to the debtor if it expects all other banks to stop lending. If all banks have the same expectation of no further lending by other banks, the result is self-confirming.

Krugman shows that collusive action on the part of creditors, by allowing banks to offer lower interest rates and large enough new loans, can avert the debt crisis that may arise if creditors acted competitively. He points out the free-rider problem that may exist, however, if creditors are not perfectly collusive.

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² See Kahler (1986) for a review of these theories.

Bulow and Rogoff use a Rubinstein (1982) type bargaining model to examine how a debtor country and a bank negotiate over repayment of a loan. The subgame perfect equilibrium is characterized by both parties achieving an agreement instantaneously and, if the solution lies in the "bargaining region," the relative shares of each party are in inverse proportion to their respective rate of impatience in reaching a settlement.

Fernandez and Rosenthal look at a game between debtor and creditor in the context of a neoclassical growth model. They show that although some forgiveness of the debt may occur (when the debt is "too" large), the creditor is nonetheless able to extract all the "surplus" available from the game.

Fernandez and Glazer examine the question of whether two or more debtors facing the same creditor can successfully collude against the latter.

The paper that most closely shares our concerns is Caskey's. He also examines a game between small and large banks. His analysis is primarily focused, however, on the IMF's role in obtaining greater participation from the small banks. The IMF tactic of not participating in an adjustment program unless there is a critical mass of banks forces small banks to take into account the effect of their nonparticipation on the probability of success of the program.³

None of the above analyses, however, examine the effect that reputational considerations may have on negotiations.⁴ The fact that favorable terms obtained by one country are almost always referred to in subsequent negotiations by other countries and that all the repercussions of one country's moratorium are closely studied by the other debtor countries, indicates that these may play an extremely important role in reality.⁵

Where may reputational considerations affect the negotiation process? In order to (partially) answer this question, a brief overview of the rescheduling process is helpful. Rescheduling is an extremely complicated process involving hundreds of banks and loans of various maturities and terms. In a typical scenario, a troubled debtor approaches a major creditor and asks for changes in its repayment schedule. This bank then consults with other important creditors and a creditor committee is set up. There does not exist any simple harmony of interest among creditors, however. They are a heterogeneous group characterized by different degrees of exposure to the various countries, by different economic ties to each borrower, and by different roles played within the field of international banking.

An obvious differentiation among banks is by size: there is a small group of very large international banks such as Citibank, Chase, Lloyds, etc. and then a much

³ We wish to thank an anonymous referee for bringing this article to our attention.

⁴ By reputation we mean the "reputation effect" whereby a player may seek, through various actions, to pretend to be of a different type other than its true one. This should not be confused with the reputational arguments commonly referred to in the sovereign-debt literature in which a country repays its debt in order to preserve its "reputation" as a "good" debtor even in the absence of any uncertainty. The validity of this latter argument has been examined by, among others, Eaton and Gersovitz (1981), Bulow and Rogoff (1989b), Cohen and Sachs (1986), Rosenthal (1991), and Eaton (1989).

⁵ For example, the terms obtained by Mexico in 1986 were thought to be concessionary and were demanded in subsequent negotiations by Brazil and Argentina. Under the ongoing Brady initiative, the deals reached by Mexico with the banks are now being used as precedent by the Philippines and Costa Rica.

larger group of small banks. Renegotiation is essentially carried out by the large banks. These are the banks that sit on the creditor committee, engage in data collection, come up with the new terms of amortization and with how much "new money" must be included in the rescheduling package, and reach an agreement with the debtor country. It is then up to the smaller banks to ratify the agreement.

Although the small banks have not had many problems in accepting the new terms proposed by the large banks on outstanding loans, they have been much more unhappy about providing the new loans required as part of the rescheduling package. To ensure that one bank's involuntary loans are not used to pay off the interest on another bank's loan, participation in involuntary loans has taken a pro rata form, i.e. each bank is asked to participate in all new loans in proportion to its existing exposure.

Although any individual large bank, *ceteris paribus*, would also prefer not to increase its exposure to the debtor countries, there is a fundamental asymmetry between large and small banks: the larger banks have a much greater stake in the renegotiation process than do the smaller ones. Not only are they the largest creditors, but also their exposure relative to capital is much higher.⁶ Moreover, as emphasized by Lipson (1986), large banks perceive themselves as having permanent interests in the stable operation of international capital markets. They have long-standing ties both to other major institutional players and to many of the debtor countries. Their relationship often extends to state agencies, local firms, and to the domestic banking system of the debtor country. To the extent that there is a long-run benefit from maintaining these relationships and a greater vulnerability to any writedown in the value of outstanding loans, a large bank will be more willing to participate in involuntary loans than a small bank with less exposure and with no such permanent ties to the international community or to a sovereign debtor.

The greater reluctance of smaller banks to participate in involuntary loans often implies that the larger banks must resort to pressuring the smaller ones in order to ensure participation. An attempt by a small bank to hold out can be met by the threat of blacklisting from future international lending and, more importantly, by threats to its domestic operations since large banks provide important services to small banks in the domestic market. As a last resort, as recounted by Kraft (1984) in the Mexican case, the Federal Reserve or the Treasury may also bring pressure to bear.

The negotiation process, therefore, could be conceived of as the interplay of three games: one between the large creditors (the creditor committees) and the debtor countries, another solely among the large creditors,⁷ and a last one between

⁶ For example, at the end of 1986 the nine major US banks' exposure to all LDC debtors was 153.9 percent of capital as compared to 55 percent for all other banks. See Sachs and Huizinga (1987) for a review of the bank statistics.

⁷ Different regulatory practices give the Japanese, European, and American banks opposing interests in how to treat, for example, unpaid interest and, therefore, different preferences as to the terms of the final agreement with the debtor.

the large banks and the small banks.⁸ Our analysis will completely ignore any problems that may exist among the large creditors in order to focus on the interaction between the small banks-large banks game and the negotiations between the large banks and the debtors.

The primary objective is to examine how differences among banks' interests influences rescheduling. We show that the presence of small banks and the existence of uncertainty on the part of the country as to how much pressure a big bank may be able to exert over a small one results in harsher terms for the debtor country. Negotiations are no longer necessarily smooth processes with agreements reached instantaneously. Instead they will be characterized by frequent breakdowns. The presence of asymmetric information gives rise to a reputation effect and to a dynamic game in which partial defaults may occur.

2. THE MODEL

Reflecting the reality of the negotiation process, negotiations are thought of as taking place between big banks and the debtor country over the terms of repayment of all loans, and between big and small banks as to the degree of participation of small banks in new involuntary loans. We first turn to a general description of the game. There are two alternative interpretations of the dynamics of the model that we present. One is of a single country engaged in a fixed number of negotiations of different portions of its debt with the same consortium of banks. The other, perhaps more plausible interpretation, is that of a given number of countries sequentially negotiating their debt packages with the same international banks. We shall refer to both interpretations in the text. In both cases, what is of essence is that the information revealed in one negotiation can then be made use of in all subsequent negotiations.

Consider then a country engaged in paying its debt over N periods. In each period, L is the amount of debt that has come due and is being renegotiated.⁹ The country attempts to obtain new money, $F \geq 0$, in order to finance this repayment. The new money can best be conceived of as partial forgiveness of the debt or as new long-term loans which will then be refinanced in the far future. If the country and the banks do not come to an agreement, the country is considered to be in default that period. The costs it incurs in doing so, $D > 0$, reflect the costs of being restricted to barter trade and/or from being barred from any form of international lending during that period. Alternatively, we can consider a scenario in which there are N countries, each engaged in (sequentially) negotiating its debt of L . Once again, D is the cost of failing to reach an agreement and being declared in default.

The large banks are assumed to act collusively as a single agent denoted by B .¹⁰

⁸ Of course, any such division is arbitrary. For example, we have omitted the games between any subsets of banks, the creditor-countries, their citizens, domestic institutions, and multilateral players such as the IMF and the World Bank.

⁹ Allowing the amount that has come up for renegotiation to be constant across periods considerably simplifies the mathematical exposition, but is in no way essential to our story.

¹⁰ A collusive outcome could be the result of, for example, the fact that these big banks are also simultaneously participating in collusive arrangements in other arenas. Defection in the arena of

The small banks, however, are perfect competitors; they take the terms of agreement reached by the large banks and the country as given and, as legally specified, will share in any *payment* by the country in a pro rata fashion. The small banks, however, are not legally required to participate in involuntary lending. Thus, each bank will simply decide, given F , whether it wishes to increase its exposure (or, equivalently, forgive part of the debt). Participation, in any case, will never be required to exceed its pro rata share of F .¹¹

Why would the small banks ever participate? The incentive to participate results from the costs that will be imposed on them by the large banks if they fail to do so. These costs can result from being blacklisted from future international lending and, more importantly, from domestic loan participation and from the use of banking services provided by the big banks. The relationship between large and small banks is asymmetrical. Although it is a mutually beneficial relationship, there are many small banks to which a large money-center bank provides its services and not vice-versa. Thus, the severance (or restriction) of a relationship between a large bank and a small bank is a great deal more costly for the latter. We assume that big banks incur zero transaction costs in applying pressure to small banks, so that, subject to participation not exceeding the small bank's pro rata share, the large banks will attempt to extract as much participation of the small banks in F as is feasible.¹² To simplify this game, we assume that the large banks are able to make each small bank a take-it-or-leave-it offer specifying the quantity of new money that each small bank should contribute if it does not wish to be penalized. Without any loss of generality, we can aggregate all small banks into one, denoted by S .

The payoffs in a period to the big bank, the small bank, and the country that is renegotiating its debt that period are as follows:

$$\begin{aligned}
 \pi_c &= \begin{cases} -L + F & \text{if agreement} \\ -D & \text{if no agreement} \end{cases} \\
 (1) \quad \pi_b &= \begin{cases} L_b - F_b & \text{if agreement} \\ 0 & \text{if no agreement} \end{cases} \\
 \pi_s &= \begin{cases} L_s - F_s & \text{if agreement and } S \text{ participates} \\ L_s - \gamma & \text{if agreement and } S \text{ does not participate} \\ 0 & \text{if no agreement,} \end{cases}
 \end{aligned}$$

international debt would then instigate defection in other areas. Alternatively, it could also be the outcome of an infinitely repeated game (not necessarily with the same countries), since these banks perceive themselves to be permanent players in the international market.

¹¹ While there is no legal restriction on the amount of new money which small banks may contribute, the tacit agreement (supported by the IMF in its role as coordinator of the negotiating banks) is that banks participate in a pro rata fashion. If this were not the case, then a country could use one's bank's forgiveness or new money to pay off another bank, exactly the situation that was meant to be avoided by instituting pro rata payment of any sum of money paid by a debtor.

¹² This can be generalized to include a small cost to penalizing the small banks.

where "agreement" signifies an agreement in that period between the large bank and the country in which the country agrees to repay L and the big bank agrees to an aggregate forgiveness of F . "Participation" implies that the small bank has agreed to contribute F_s , and thus that the large bank must contribute $F_b = F - F_s$. γ is the maximum cost that the large banks can inflict on S , and $L_j j = b, s$ is the amount of the country's repayment of L that corresponds to j according to the pro rata rule (note $L_b + L_s = L$). Subscripts c, b , and s denote the country, the big and the small bank respectively. L_b, L_s, γ , and D are exogenously specified.

Note that the way that we have written the payoffs already takes into account the take-it-or-leave-it nature of the game between B and S . A rejection of the large bank's demand for a contribution automatically invokes a punishment of γ . Thus, if $\alpha = L_s/L$ is S 's pro rata share, the large bank can extract $\min(\alpha F, \gamma)$ from S . The equilibrium of the game between small and large banks, therefore, has the latter demanding a contribution of $F_s = \min(\alpha F, \gamma)$ and the former acquiescing. Note, therefore, that if there is no agreement the small bank contributes zero new money.

Although the degree to which a large bank can harm a small bank may be common knowledge between these two agents, it may be very difficult for a country to know how much pressure big banks can exert on small banks. This would tend to depend on many factors: the institutional environment, the asset/liability position of each bank, and any other number of factors that impinge on the political-economic environment. It is sensible to assume, therefore, that the country is uncertain about the maximum amount of pressure that the large bank can exert. For simplicity we assume that the maximum cost that big banks can inflict on small banks may take one of two values, either high or low, i.e. $\gamma \in \{\gamma_H, \gamma_L\}$, $\gamma_H > \gamma_L \geq 0$.¹³

We now turn to a description of the game played between the large bank and the country(ies). It is well known that the equilibria of a noncooperative game played between two agents is very sensitive to the institutional framework in which the game is embedded. Furthermore, the analysis required is quite complex. As a result, there have been few explicitly strategic analyses of the debt crisis (two exceptions are Bulow and Rogoff 1989a, and Fernandez and Rosenthal 1990). In this paper we do not undertake to solve a particular noncooperative model of the asymmetric information bargaining problem between the large bank and the country(ies) in each period of negotiation. Instead, we assume that the solution to the bargaining problem is given by the Nash bargaining solution in a way that will be made clear below. While the imposition of a Nash bargaining solution is admittedly ad hoc (with the unappealing property that it imposes a cooperative solution), we argue that the particular solution concept adopted is not essential for our results; what matters is the ranking of the payoffs in a way that will be made explicit further on in the paper.

Any solution to the bargaining problem between the debtor country and its

¹³ In reality there are many small banks and also a number of large banks. Each small bank may be more or less susceptible to any pressure that the larger banks can exert. What is unknown to the country is whether the value of the aggregate cost that can be inflicted across all small banks is high or low.

creditors naturally will depend on the true value of γ , and on the country's belief as to the value of γ . We assume that the country and the big bank can give instructions to their respective negotiating teams to negotiate as if the true value of γ were either γ_H or γ_L , regardless of its true value and of what the country believes its true value to be. In each period the sequence of moves is as follows: the country first declares whether it wishes to take a "tough" stance and negotiate as if $\gamma = \gamma_H$ or a "conciliatory" stance and negotiate as if $\gamma = \gamma_L$. It is then the big bank's turn to move. In turn it also must declare whether it wishes to be "tough" and negotiate as if $\gamma = \gamma_L$ or if it wishes to be "conciliatory" and negotiate as if $\gamma = \gamma_H$. Note that the same choice of γ strategies have different names associated with them according to which player is making the choice (e.g. γ_H is tough for C and conciliatory for B). From here on, $\hat{\gamma}$ indicates the value of γ declared by a negotiating team, i.e. $\hat{\gamma} = \hat{\gamma}_i$, $i = H, L$.

Suppose that in some period both the big bank and the country play tough (i.e. the bank declares $\hat{\gamma}_L$ and the country $\hat{\gamma}_H$). Then, in that period no agreement is reached and a default is declared. The country suffers a default penalty of D , the large and the small bank obtain zero, and the small bank suffers no penalty. Suppose instead that the value of $\hat{\gamma}$ communicated to the respective negotiating teams is the same. Then the value of the payoffs is given by the solution to the Nash bargaining problem in (2). That is, \hat{F}_b is chosen to solve

$$(2) \quad \begin{aligned} & \max [\pi_c(F) + D [\pi_b(F)] , \\ & \text{s.t. } \hat{F}_b \geq 0 \end{aligned}$$

where F can be written as $F = \hat{F}_b + \hat{F}_s$ and¹⁴

$$(3) \quad \hat{F}_s = \begin{cases} (L_s/L_b)\hat{F}_b & \text{if } \hat{\gamma} > (L_s/L_b)\hat{F}_b \\ \hat{\gamma} & \text{if } \hat{\gamma} \leq (L_s/L_b)\hat{F}_b . \end{cases}$$

Thus (2) can be rewritten as

$$(4) \quad \max_{\hat{F}_b} [-L + \hat{F}_b + \hat{F}_s + D][L_b - \hat{F}_b] .$$

The first order condition yields

$$(5) \quad \hat{F}_b = (.5)[L_b - \hat{\gamma} - D + L] \quad \text{if } \hat{\gamma} < (L_s/L_b)\hat{F}_b$$

(alternatively the constraint can be written as $\hat{\gamma} < (L_b + L - D)/(L_b + L)$), and

$$(6) \quad \hat{F}_b = \frac{L_b(2L - D)}{2L} \quad \text{if } \hat{\gamma} > (L_s/L_b)\hat{F}_b$$

(alternatively, the constraint can be written as $\hat{\gamma} > L_s(2L - D)/(2L)$).

We examine only those cases in which $F > 0$.¹⁵ As shown in Table 1, we can distinguish among six cases. The table gives the proposed level of forgiveness, \hat{F}_b

¹⁴ We do not allow the country to make the banks "gifts" of money, i.e. to pay more than what it owes.

¹⁵ We are implicitly assuming, therefore, that $L > D/2$.

TABLE 1

	$\hat{\gamma}_L$	$\hat{\gamma}_H$
Case 1	$\hat{F}_s = \gamma_L$ $\hat{F}_b = (5)$	$\hat{F}_s = \gamma_H$ $\hat{F}_b = (5)$
Case 2	$\hat{F}_s = \gamma_L$ $\hat{F}_b = (5)$	$\hat{F}_s = \gamma_H$ $\hat{F}_b = (L_b/L_s)\gamma_H$
Case 3	$\hat{F}_s = \gamma_L$ $\hat{F}_b = (5)$	$\hat{F}_s = (L_s/2L)(2L-D)$ $\hat{F}_b = (6)$
Case 4	$\hat{F}_s = \gamma_L$ $\hat{F}_b = (L_b/L_s)\gamma_L$	$\hat{F}_s = \gamma_H$ $\hat{F}_b = (L_b/L_s)\gamma_H$
Case 5	$\hat{F}_s = \gamma_L$ $\hat{F}_b = (L_b/L_s)\gamma_L$	$\hat{F}_s = (L_s/2L)(2L-D)$ $\hat{F}_b = (6)$
Case 6	$\hat{F}_s = (L_s/2L)(2L-D)$ $\hat{F}_b = (6)$	$\hat{F}_s = (L_s/2L)(2L-D)$ $\hat{F}_b = (6)$

distinguish among six cases. The table gives the proposed level of forgiveness, \hat{F}_b and \hat{F}_s , as a function of the value of $\hat{\gamma}$ that is agreed upon by the country and the large bank. The proposed and actual levels of forgiveness need not coincide (although the proposed and actual *total* forgiveness must) since γ need not equal $\hat{\gamma}$. While \hat{F}_b and \hat{F}_s depend solely on the declared values of γ , i.e. on $\hat{\gamma}$, F_b and F_s will also depend on the actual value of γ . Take, for example, case 5. If $\gamma = \gamma_L$ and $\hat{\gamma} = \hat{\gamma}_H$ then, although the bargaining solution calls for the large bank to forgive $\hat{F}_b = L_b(2L - D)(2L)^{-1}$ and for the small bank to forgive $\hat{F}_s = L_s(2L - D)(2L)^{-1}$, the fact that the latter is greater than γ_L (the maximum pressure that in reality the large bank can exert over the small) implies that the large bank will in fact have to forgive $F_b = [L_b(2L - D)(2L)^{-1}] + [L_s(2L - D)(2L)^{-1}] - \gamma_L = [(2L - D)(.5)] - \gamma_L > \hat{F}_b$ in order to make up the difference between \hat{F}_s and γ_L .

Figure 2 is a graphical representation of the Nash solution for case 2 in which when both parties declare $\hat{\gamma}_L$, $\hat{F}_s = \gamma_L$ and \hat{F}_b is given by equation (5), and when both parties declare $\hat{\gamma}_H$, $\hat{F}_s = \gamma_H$ and $\hat{F}_b = (L_b/L_s)\gamma_H$.

For the sake of mathematical simplicity we focus solely on those cases in which the payoff to the large bank in a negotiation in which both parties have declared $\hat{\gamma}_L$ is the same regardless of the true value of γ , i.e. $\pi_b(\hat{\gamma}_L, \gamma_H) = \pi_b(\hat{\gamma}_L, \gamma_L)$ where $\pi_b(\hat{\gamma}_i, \gamma_j)$ $i = H, L, j = H, L$ is the one-period payoff to the large bank when both parties declare $\hat{\gamma}_i$ when in reality $\gamma = \gamma_j$.¹⁶ We denote this common value of the payoff $\pi(\hat{\gamma}_L)$. This restricts us to cases 4–6 (in all the other cases $\pi_b(\hat{\gamma}_L, \gamma_H) > \pi_b(\hat{\gamma}_L, \gamma_L)$).

Lastly, in order to obtain a reputational effect, henceforth we assume that the parameters are such that $\pi_b(\hat{\gamma}_H, \gamma_L) < 0$. That is, if both parties play $\hat{\gamma}_H$ when in reality $\gamma = \gamma_L$, then the payoff that period to the large bank is negative. Recall that when the negotiation presumes that the large bank has more power over the small banks than what it really does, the large bank must come up with more new money (or equivalently additional forgiveness) on its own to make up for the fact that it is not able to exert enough pressure on the small bank to extract from it the

¹⁶ Note that this assumption is not of essence to the qualitative results but, as should be clear from the discussion of strategies that follows, it simplifies all the calculations.

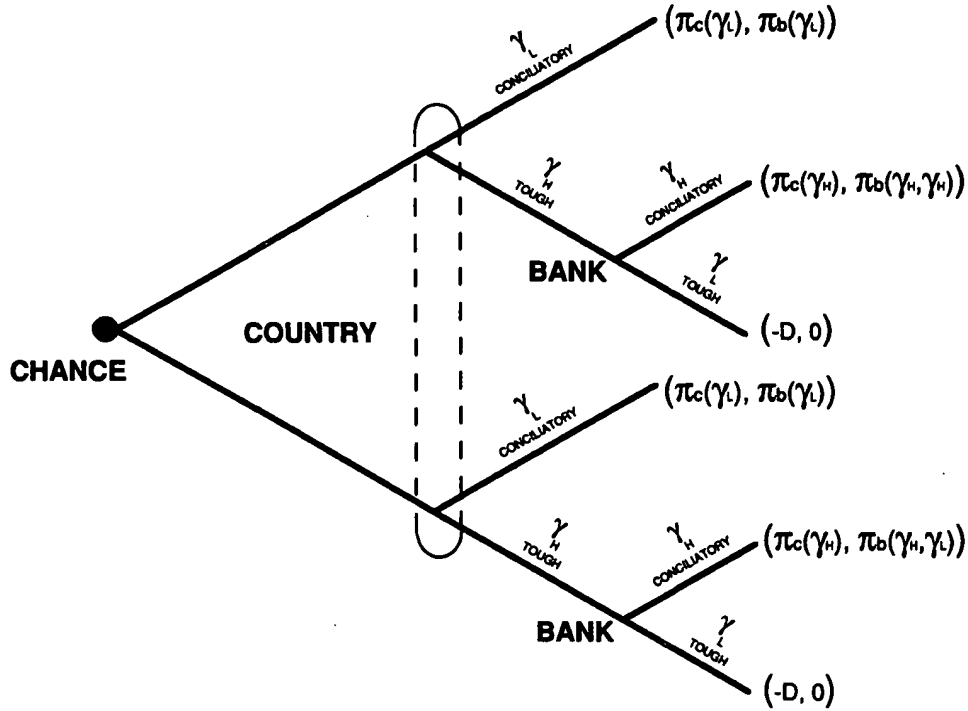


FIGURE 1

appropriate pro rata share. If the difference between γ_H and γ_L is sufficiently large, then $\pi_b(\hat{\gamma}_H, \gamma_L) < 0$.¹⁷ This can occur in cases 4 and 5 but not in 6.¹⁸ Hereafter we restrict our attention to the cases in which this is so.

The extensive form of the game described in the preceding paragraphs is shown in Figure 1 (for one period). $\pi_c(\hat{\gamma}_L)$ is the country's payoff when both parties play $\hat{\gamma}_L$, and $\pi_c(\hat{\gamma}_H)$ is its payoff when both parties play $\hat{\gamma}_H$. Note that, unlike the large bank, the country's payoff given $\hat{\gamma}$ depends only on the choice of strategies, and not on the actual value of γ .

All parties—the country(ies), the large and the small bank—attempt to maximize the sum of their own payoffs over the entire game.

In a static and complete information version of this game, the subgame-perfect Nash equilibrium is $(\hat{\gamma}_L, \hat{\gamma}_L)$ if $\gamma = \gamma_L$ and $(\hat{\gamma}_H, \hat{\gamma}_H)$ if $\gamma = \gamma_H$, where the first term in the parenthesis refers to the negotiation stance taken by the country and the second to that taken by the bank. The reasoning behind this result is as follows. When $\gamma = \gamma_L$, $\pi_b(\hat{\gamma}_H, \gamma_L) < 0$. Consequently, the large bank will declare $\hat{\gamma}_L$ should the country declare $\hat{\gamma}_H$. Knowing this, and preferring $\pi_c(\hat{\gamma}_L)$ to $-D$, the country declares $\hat{\gamma}_L$. If, on the other hand $\gamma = \gamma_H$, then $\pi_b(\hat{\gamma}_H, \gamma_H) > 0$. Since

¹⁷ "Sufficiently large" in terms of the parameter restrictions it imposes in case 4 implies $(L_b + \gamma_L)L_s < L\gamma_H$ and in case 5 implies $2L - D < 2\gamma_L$.

¹⁸ In case 6, $\pi(\hat{\gamma}_H, \gamma_L) = \pi(\hat{\gamma}_L, \gamma_L)$ and thus cannot, by the individual rationality constraint, be strictly negative.

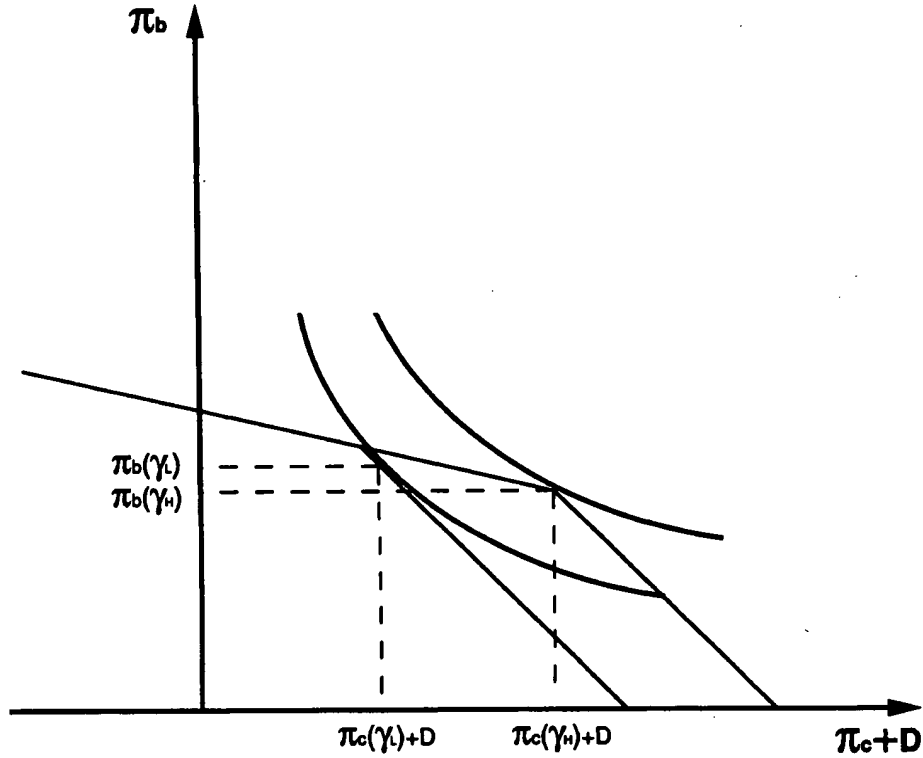


FIGURE 2

$\pi_c(\hat{\gamma}_H) > \pi_c(\hat{\gamma}_L)$, the country will declare $\hat{\gamma}_H$ knowing that the large bank will do likewise. In this situation the big bank cannot credibly threaten to play tough since, if called upon to do so, it would be made worse off than by acquiescing and being conciliatory. The requirement that strategies be subgame perfect, i.e. that strategies induce Nash equilibria in every proper subgame of the game, rules out equilibria based on noncredible threats.

If this game of complete information is played N times, the equilibrium is the same as in the static case since, by backwards induction (as in the chain-store paradox), there is nothing to be gained by a large bank with $\gamma = \gamma_H$ from playing $\hat{\gamma}_L$. The knowledge that in the last period the bank will play $\hat{\gamma}_H$ unravels any threat that the large bank will play $\hat{\gamma}_L$ in any prior period. The large bank cannot establish a reputation for being "tough." When $\gamma = \gamma_L$, on the other hand, the large bank's threat to play $\hat{\gamma}_L$ when the country has played $\hat{\gamma}_H$ is credible since, by assumption, the large bank prefers a disagreement, and hence a payoff of zero that period, to forgiving in addition the difference between \hat{F}_s and γ_L .

In a game of imperfect information, however, the fact that the game is played over N periods rather than solely over one implies that there may be an incentive for the bank to take a tough position, i.e. to play $\hat{\gamma}_L$, even if $\gamma = \gamma_H$, in the hope

of convincing the country that it has little bargaining power over the small bank. As has been shown by Kreps and Wilson (1982b), for a large enough N the reputational effect comes into play.

The general structure of the game is as follows. There are N periods in which the game shown in Figure 1 is played. Time is indexed backwards so that first stage N is played, then $N - 1, \dots$, then 1. The possible payoffs of the big bank depend on γ , whereas those of the country(ies) are independent of γ . Both of their payoffs, of course, depend on $\hat{\gamma}$. The bank knows the true value of γ . The country, on the other hand, starts out with an exogenously specified initial belief as to the probability that $\gamma = \gamma_L$. This probability is p_N .

As in Kreps and Wilson, we look for a sequential equilibrium. Three conditions must be fulfilled for a sequential equilibrium: 1) Each player called upon to make a move has a probability estimate over what previously occurred. 2) The estimate satisfies Bayes' rule, whenever the latter applies. 3) At every node, including nodes off the equilibrium path, the players follow optimal strategies given their probability assessment of that node and contingent on the prior history of moves.

Sequential equilibria possess the following properties:¹⁹ a) Every extensive game has at least one sequential equilibrium. b) If a set of beliefs and strategies for the players constitutes a sequential equilibrium, then the set of strategies constitutes a subgame-perfect Nash equilibrium.

A sequential equilibrium to the game is given below. It is described by a function p_n , a strategy for the country, and a strategy for the big bank. We shall then proceed to show that these constitute a sequential equilibrium.

The Country's Probability Assessment, p_n :

- a) If the country adopts a conciliatory position ($\hat{\gamma}_L$) in period $n + 1$, then $p_n = p_{n+1}$.
- b) If both the country and the bank play tough in period $n + 1$, then $p_n = \max(b^n, p_{n+1})$, where

$$(7) \quad b = [\pi_c(\hat{\gamma}_H) - \pi_c(\hat{\gamma}_L)] / [\pi_c(\hat{\gamma}_H) + D].$$

- c) If the country plays tough ($\hat{\gamma}_H$) in period $n + 1$ and either the bank adopts a conciliatory position ($\hat{\gamma}_L$) or $p_{n+1} = 0$, then $p_n = 0$.

This is a complete description of how p_n is computed at every node of the game.

Strategies:

The Country. At each period n , the country compares p_n , the probability that the country assigns to the event $\gamma = \gamma_L$, with b^n . If $p_n > b^n$, the country is conciliatory. If $p_n = b^n$, the country is conciliatory ($\hat{\gamma}_L$) with probability σ , where $\sigma = \pi_b(\hat{\gamma}_H, \gamma_H) / [\pi_b(\hat{\gamma}_L) - \pi_b(\hat{\gamma}_H, \gamma_H)]$. If $p_n < b^n$, the country is tough.

The Big Bank. If $\gamma = \gamma_L$, i.e. if it can exert little power over the small bank, it always takes a tough position, i.e. plays $\hat{\gamma}_L$. If, on the other hand, $\gamma = \gamma_H$ then: If the players are in the last period of negotiation, that is, if

¹⁹ See Kreps and Wilson (1982a) for a fuller discussion of sequential equilibria.

$n = 1$, the bank is conciliatory ($\hat{\gamma}_H$). If $n > 1$ and $p_n \geq b^{n-1}$, the bank plays tough. If $n > 1$ and $p_n < b^{n-1}$, the bank randomizes and takes a tough position ($\hat{\gamma}_L$) with probability X_n , where $X_n = [p_n(1 - b^{n-1})]/[(1 - p_n)b^{n-1}]$.

The beliefs and strategies described above constitute a sequential equilibrium. This can be demonstrated by showing that the beliefs of the country are consistent with the strategy of the bank (in the sense that Bayes' rule holds where ever it applies) and that, given one agent's strategy, the other agent is following a payoff maximizing strategy.

We first verify that beliefs are consistent. When the country is conciliatory no information is gained, so $p_{n-1} = p_n$. If $p_n \geq b^{n-1}$, the bank is tough with probability one. If $p_n = 0$, the bank (with $\gamma = \gamma_H$) is conciliatory with probability one. Hence, as long as the big bank follows its strategy, by Bayes' rule $p_{n-1} = p_n$ in both cases. If $p_n \in (0, b^{n-1})$, the bank with $\gamma = \gamma_H$ is tough with probability X_n . If $\gamma = \gamma_L$, the big bank is never conciliatory; only if $\gamma = \gamma_H$ does the bank ever play $\hat{\gamma}_H$. Hence, if the country observes conciliatory behavior in period n , $p_{n-1} = 0$. If in period n the bank played tough, then Bayes' rule requires:

$$(8) \quad p_{n-1} = \frac{\text{pr}(\gamma_L|\hat{\gamma}_L)}{\text{pr}(\hat{\gamma}_L)} = \frac{\text{pr}(\gamma_L)}{\text{pr}(\hat{\gamma}_L|\gamma_L)\text{pr}(\gamma_L) + \text{pr}(\hat{\gamma}_L|\gamma_H)\text{pr}(\gamma_H)} = p_n/[p_n + X_n(1 - p_n)] = b^{n-1}$$

where $\text{pr}(\gamma_L|\hat{\gamma}_L)$ is the probability that $\gamma = \gamma_L$ given that the bank played $\hat{\gamma}_L$, $\text{pr}(\hat{\gamma}_i|\gamma_j)$ is the probability that the bank played $\hat{\gamma}_i$ given that in reality $\gamma = \gamma_j$, and $\text{pr}(\gamma_i)$ is the country's prior assessment of the probability that the big bank's power over the small bank is γ_i (i.e. p_n). This confirms that beliefs and strategies are Bayesian consistent.

Bayes' rule does not apply in two different scenarios: (i) $p_n \geq b^{n-1}$ and the bank adopts a conciliatory stance, and (ii) $p_n = 0$ and the bank adopts a tough position. In both cases we set $p_{n-1} = 0$. That is, it is assumed that any conciliatory behavior on the part of the bank demonstrates, once and for all, that the true value of γ is γ_H . While in Kreps and Wilson (1982b) this assignment of beliefs off the equilibrium path is somewhat arbitrary, in the context of our problem if we assume, very plausibly, that the portion of involuntary loans (or debt forgiveness) made by the big bank and that made by the small bank can be observed separately by the country, then conciliatory behavior on the part of the big bank does indeed reveal γ .

X_n is derived by calculating a probability with which the bank with $\gamma = \gamma_H$ plays tough in period n such that it renders the country indifferent between playing either $\hat{\gamma}_L$ or $\hat{\gamma}_H$ the following period. If in period $n - 1$ the country plays soft it obtains a payoff of $\pi_c(\hat{\gamma}_L)$ with probability one. If it plays tough, on the other hand, it obtains $-D$ with probability $p_{n-1} + (1 - p_{n-1})X_{n-1}$ and a payoff of $\pi_c(\hat{\gamma}_H)$ with probability $(1 - p_{n-1})(1 - X_{n-1})$. By Bayes' rule (see (8)), $p_{n-1} = p_n/[p_n + X_n(1 - p_n)]$. Hence in choosing X_n for a given p_n , the bank determines p_{n-1} . But, as

(9) indicates, the indifference calculation also requires knowledge of X_{n-1} :

$$(9) \quad \pi_c(\hat{\gamma}_L) = (1 - p_{n-1})[X_{n-1}(-D) + (1 - X_{n-1})\pi_c(\hat{\gamma}_H)] + p_{n-1}(-D).$$

X_{n-1} can be calculated by making use of Bayes' rule once again to find that value of X_{n-1} that generates a p_{n-2} such that (9) will hold in period $n - 2$. Iteration on (9) generates the following system of equations:

$$(10) \quad \pi_c(\hat{\gamma}_L) = (1 - p_{n-2})[X_{n-2}(-D) + (1 - X_{n-2})\pi_c(\hat{\gamma}_H)] + p_{n-2}(-D)$$

⋮

$$\pi_c(\hat{\gamma}_L) = (1 - p_1)[X_1(-D) + (1 - X_1)\pi_c(\hat{\gamma}_H)] + p_1(-D).$$

X_1 , however, necessarily equals zero since in the last round there no longer exist any dynamic considerations (i.e., there is no reputation to be gained by being tough) and the payoff for playing tough given $\gamma = \gamma_H$ is smaller than the payoff for playing conciliatory. Hence, the bank (with $\gamma = \gamma_H$) is always conciliatory in the last round.

Solving (10) given $X_1 = 0$ and using Bayes' rule yields, for $p_n \in (0, b^{n-1})$:

$$(11) \quad p_{n-1} = b^{n-1},$$

$$X_n = p_n(1 - b^{n-1})/b^{n-1}(1 - p_n).$$

The first line of (11) gives the country's probability estimate in period $n - 1$ of the bank's true value of γ equalling γ_L given that in period n both the bank and the country played tough. Note that if $p_n = 0$, then $X_n = 0$, and if $p_n = b^{n-1}$, then $X_n = 1$.

If $p_n = b^n$ then, looking at one-period payoffs, the country is indifferent between playing $\hat{\gamma}_L$ and $\hat{\gamma}_H$. We shall later show that this statement is also true if the same country is involved in all N negotiations, in which case it would care about the sum of payoffs over the n periods. The country employs a mixed strategy and chooses a probability σ_n with which to play conciliatory. σ_n is derived by finding a probability with which the country plays conciliatory in period n such that the bank (with $\gamma = \gamma_H$) is made indifferent between playing tough and playing conciliatory. Since we will only be referring to the payoffs relevant to the large bank with $\gamma = \gamma_H$, we shall for notational simplicity refer to $\pi_b(\hat{\gamma}_H, \gamma_H)$ as $\pi_b(\hat{\gamma}_H)$.

In the last period of the game the big bank's payoff is

$$(12) \quad \Pi_b = \begin{cases} \pi_b(\hat{\gamma}_H) & \text{if } p_1 < b \\ \sigma_1 \pi_b(\hat{\gamma}_L) + (1 - \sigma_1) \pi_b(\hat{\gamma}_H) & \text{if } p_1 = b, \end{cases}$$

since if $p_1 < b$ the country plays tough, and if $p_1 = b$ the country randomizes.

In the second to last period, the big bank's payoff for the remaining periods is, if $p_2 < b^2$,

$$(13) \quad \Pi_b(\hat{\gamma}_H) = 2\pi_b(\hat{\gamma}_H)$$

$$\Pi_b(\hat{\gamma}_L) = 0 + \Pi_b(p_1 = b),$$

where $\Pi_b(\hat{\gamma}_i)$ is the expected payoff of the big bank (with $\gamma = \gamma_H$) over the remaining periods of the game given that it adopts the strategy of $\hat{\gamma}_i$, $i = H, L$ in the first period under consideration in which the country is tough. $\Pi_b(p_n = b^n)$ is its expected payoff for the n remaining periods given $p_n = b^n$. Thus (13) gives the expected payoff to the large bank from adopting either of its pure strategies.

Setting equal the two payoffs in (13), we find

$$(14) \quad \sigma_1 = \pi_b(\hat{\gamma}_H) / [\pi_b(\hat{\gamma}_L) - \pi_b(\hat{\gamma}_H)].$$

If $p_2 = b^2$, the pure strategy payoffs are

$$(15) \quad \begin{aligned} \Pi_b(\hat{\gamma}_H) &= \sigma_2[\pi_b(\hat{\gamma}_L) + \pi_b(\hat{\gamma}_H)] + (1 - \sigma_2)2\pi_b(\hat{\gamma}_H) \\ \Pi_b(\hat{\gamma}_L) &= \sigma_2[\pi_b(\hat{\gamma}_L) + \pi_b(\hat{\gamma}_H)] + (1 - \sigma_2)[0 + \Pi_b(p_1 = b)]. \end{aligned}$$

In the third to last period of the game, if $p_3 < b^3$

$$(16) \quad \begin{aligned} \Pi_b(\hat{\gamma}_H) &= 3\pi_b(\hat{\gamma}_H) \\ \Pi_b(\hat{\gamma}_L) &= 0 + \Pi_b(p_2 = b^2). \end{aligned}$$

Setting the two payoffs in (16) equal, using (15), yields

$$(17) \quad \sigma_2 = \pi_b(\hat{\gamma}_H) / [\pi_b(\hat{\gamma}_L) - \pi_b(\hat{\gamma}_H)].$$

By induction, the general form of the expected payoff to the bank with n periods remaining in the game is, if $p_n < b^n$

$$(18) \quad \Pi_b(\hat{\gamma}_L) = 0 + \Pi_b(p_{n-1} = b^{n-1}) = \Pi_b(\hat{\gamma}_H) = n\pi_b(\hat{\gamma}_H)$$

and, if $p_n = b^n$, is

$$(19) \quad \begin{aligned} \Pi_b(\hat{\gamma}_L) &= \sigma_n[\pi_b(\hat{\gamma}_L) + \Pi_b(p_{n-1} < b^{n-1})] + (1 - \sigma_n) \\ &\quad \times [0 + \Pi_b(p_{n-1} = b^{n-1})] = \Pi_b(\hat{\gamma}_H) = \sigma_n[\pi_b(\hat{\gamma}_L) \\ &\quad + (n-1)\pi_b(\hat{\gamma}_H)] + (1 - \sigma_n)n\pi_b(\hat{\gamma}_H) \\ &= (n+1)\pi_b(\hat{\gamma}_H) \end{aligned}$$

and²⁰

$$(20) \quad \sigma_1 = \sigma_2 = \sigma_n = \sigma = \pi_b(\hat{\gamma}_H) / [\pi_b(\hat{\gamma}_L) - \pi_b(\hat{\gamma}_H)].$$

We now turn to verifying that the players' strategies are optimal. It is easy to show (see equation (9)) that if the country's estimate V (where $V = p_n + (1 - p_n)X_n = p_n/b^{n-1}$) of the probability that the big bank will play tough is less than b , then the country's expected payoff in that period is strictly greater if the country adopts a tough position rather than a conciliatory one. That is, if $p_n < b^n$, the country optimizes by playing $\hat{\gamma}_H$. Note that V takes into account the fact that the country does not know which type of bank it is facing.

²⁰ Note, however, that if $p_N = b^N$ for some $n \leq N$, any randomization is valid in that period.

If $p_n \geq b^{n-1}$, the bank, independently of its type, is tough with probability one. Hence it is optimal for the country to be conciliatory. If $b^n < p_n < b^{n-1}$, the bank is conciliatory with a positive probability but with a probability less than $1 - b$. Hence, once again it does not pay for the country to play tough.

To be consistent with our alternative interpretation of the same country facing the same large bank over N periods, we must also show, however, that the country cannot gain a long-run benefit by being tough when $b^n < p_n < b^{n-1}$. That it cannot to do so when $p_n \geq b^{n-1}$ is trivial, since the fact that the bank plays tough with probability one independent of its type means that no information would be gained in this case by the country playing $\hat{\gamma}_H$.

Let $\Pi_{c,n-1}(\hat{\gamma}_H)$ be the country's expected payoff from playing $\hat{\gamma}_H$ in period $n - 1$ given that in period n it played tough. Let $b^n < p_n < b^{n-1}$. Recalling that in the event that the bank also plays tough, p_{n-1} will equal b^{n-1} , then

(21)

$$\begin{aligned}\Pi_{c,n-1}(\hat{\gamma}_H) &= [p_n + (1 - p_n)X_n]\{[b^{n-1} + (1 - b^{n-1})X_{n-1}](-D) \\ &\quad + (1 - b^{n-1})(1 - X_{n-1})\pi_c(\hat{\gamma}_H)\} + [(1 - p_n)(1 - X_n)]\pi_c(\hat{\gamma}_H) \\ &= (p_n/b^{n-1})[b(-D) + (1 - b)\pi_c(\hat{\gamma}_H)] + [1 - (p_n/b^{n-1})]\pi_c(\hat{\gamma}_H) \\ &= \pi_c(\hat{\gamma}_H) - [D + \pi_c(\hat{\gamma}_H)](p_n/b^{n-2}).\end{aligned}$$

The expected payoff from being tough in period $n - 1$ given that the country was conciliatory in period n , and thus that $p_{n-1} = p_n$, is

(22)

$$\begin{aligned}\Pi_{c,n-1}(\hat{\gamma}_L) &= [p_{n-1} + (1 - p_{n-1})X_n](-D) + [(1 - p_{n-1})(1 - X_{n-1})]\pi_c(\hat{\gamma}_H) \\ &= \pi_c(\hat{\gamma}_H) - [D + \pi_c(\hat{\gamma}_H)](p_n/b^{n-2}).\end{aligned}$$

Note also that in both cases the country's expected payoff from being conciliatory in period $n - 1$ is $\pi_c(\hat{\gamma}_L)$, independently of its play the previous period. This verifies that the country's expected payoff in period $n - 1$ is independent of whether it played $\hat{\gamma}_L$ or $\hat{\gamma}_H$ the previous period. This, combined with the fact that the country suffers a loss in its expected payoff in period n if it is tough that period, implies that the country is following an optimal strategy by being conciliatory when $b^n < p_n < b^{n-1}$.

If $p_n = b^n$, the big bank is conciliatory with probability $1 - b$, so the country is indifferent and randomizes. An analysis similar to that conducted above confirms that there is no long-run benefit to be gained by the country from being tough with probability one.

The above analysis can also be extended to show that the expected payoff in any period $n - m$, $m < n$, is also invariant to the negotiating position chosen in period n . This follows from the fact that the expected payoff in period $n - 1$ is independent of p_{n-1} . Hence there is no dynamic advantage to be gained by deviating from the described strategy. This verifies the optimality of the country's strategy.

The optimality of the big bank's strategy if $\gamma = \gamma_L$ is easily shown. If in any period the big bank is ever conciliatory, this results in more future tough positions

taken by the country than does being tough. Since playing tough is better for the bank than playing conciliatory, and since fewer defaults are likewise better, to be tough always is the optimal strategy for the big bank with $\gamma = \gamma_L$.

We now turn to verifying the optimality of the strategy of the big bank with $\gamma = \gamma_H$. The expected payoff to the big bank with $\gamma = \gamma_H$ from following its strategy from period n to period 1 is given by the following function of p_n .

(23)

$$\begin{aligned} \Pi_b &= n\pi_b(\hat{\gamma}_H) && \text{if } p_n < b^n \\ \Pi_b &= (n+1)\pi_b(\hat{\gamma}_H) && \text{if } p_n = b^n \\ \Pi_b &= [n - k(p_n) + 1]\pi_b(\hat{\gamma}_L) + (k(p_n) - 1)\pi_b(\hat{\gamma}_H) && \text{if } b^n < p_n < b^{k(p_n)-1} \\ \Pi_b &= [n - k(p_n) + 1]\pi_b(\hat{\gamma}_L) + k(p_n)\pi_b(\hat{\gamma}_H) && \text{if } b^n < p_n = b^{k(p_n)-1}, \end{aligned}$$

where $k(p_n) = \inf\{n: b^n < p_n\}$ for $p_n > 0$.

The first two payoffs are obtained from equations (18) and (19). The third is found by noting that as long as $b^n < p_n$ the country is conciliatory and the big bank receives $\pi_b(\hat{\gamma}_L)$ in each of those periods. The last period in which this occurs is in period $k(p_n)$, at which point the bank has obtained a payoff of $\pi_b(\hat{\gamma}_L)$ over $N - k(p_n) + 1$ periods. If, in period $k(p_n) - 1$, $p_n < b^{k(p_n)-1}$, then in each period thereafter, $k(p_n) - 1$ to 1, the bank receives an expected payoff of $\pi_b(\hat{\gamma}_H)$. The last equation is the same as the third except that it covers the case in which in period $k(p_n) - 1$ we have $p_n = b^{k(p_n)-1}$ instead of the prior inequality. The expected payoff in that period is $2\pi_b(\hat{\gamma}_H)$ instead of $\pi_b(\hat{\gamma}_H)$, yielding an expected payoff of $k(p_n)\pi_b(\hat{\gamma}_H)$ over the $k(p_n)$ periods.

We must check that there are no deviations which would be profitable for the bank in every subgame. Suppose, therefore, that the country is tough in period n (and thereafter plays according to its described strategy). By playing conciliatory in that period (and thereafter playing according to its described strategy), the bank obtains $\pi_b(\hat{\gamma}_H)$ in that period and in every period thereafter. By playing tough that period (and thereafter playing according to its described strategy), on the other hand, the bank receives zero in that period and future expected payoffs of $(n-1)\pi_b(\hat{\gamma}_H)$ if $p_n = 0$, $n\pi_b(\hat{\gamma}_H)$ if $0 < p_n \leq b^{n-1}$ (see equation (19)), and more than $n\pi_b(\hat{\gamma}_H)$ if $p_n > b^{n-1}$. Thus, the big bank (with $\gamma = \gamma_H$) is optimizing by following the strategy described.²¹

3. IMPLICATIONS

Our model allows us to make a number of predictions about the negotiation process. Most significantly, negotiations will not be smooth and agreements will not be reached instantaneously; there will be extended periods during which negotiations regularly break down. This result is independent of the true value of the big bank's power over the small bank. If the bank has $\gamma = \gamma_H$, then during those periods in which the big bank defends its reputation, that is from the first period in which $p_N \leq b^n$ until the period in which the bank first adopts a conciliatory stance,

²¹ It is easy to check that any further deviations also do not increase the expected value of payoffs to the large bank.

a default will occur at least every other period. This is clearly seen from the country's strategy set and its probability estimating function. Whenever the bank adopts a tough position, this causes the country's reassessment of the probability that $\gamma = \gamma_L$ to be such that in the next period the country randomizes. If the result of this randomization is conciliatory behavior on the part of the country, in the following period the country is tough with probability one. If instead the randomization results in the country playing tough then, if the bank also plays tough, randomization occurs again next period. On the other hand, if the bank has $\gamma = \gamma_L$ it never adopts a conciliatory position. Hence default occurs at least every other period commencing with the first period in which $p_N \leq b^n$ and ending with the first instance of conciliatory behavior on the part of the bank.

The introduction of a reputational effect into the negotiation process leaves the big bank that has a large amount of power over the small bank ($\gamma = \gamma_H$) at least as well off as absent this effect. If $p_N < b^N$, the big bank is just as well off in terms of its expected payoff as without the reputation effect since in the complete certainty equilibrium $\Pi_b = N\pi_b(\hat{\gamma}_H)$. If $p_N \geq b^N$, the bank's payoff is greater with the reputational effect. This follows from (23) where the payoffs given by the last three equations are all greater than $N\pi_b(\hat{\gamma}_H)$ (since $\pi_b(\hat{\gamma}_L) > \pi_b(\hat{\gamma}_H)$). Thus the big bank's expected payoff is unambiguously larger with the reputational effect. The small bank's payoffs move in tandem with the big bank's. Therefore, the same conditions for the implications of the reputational effect apply to it. Lastly, if the big bank has little power over the small bank (i.e. $\gamma = \gamma_L$), the big bank is made worse off by the introduction of asymmetric information since in each period in which a default occurs it loses $\pi_b(\hat{\gamma}_L)$. The small bank, likewise, receives zero in each instance of default. Consequently, it is also in this case made worse off by the introduction of asymmetric information.

The country is clearly worse off as a consequence of the reputational effect. If default never occurs, the game is a zero-sum game; with default it is a negative-sum game. We have already established that given $\gamma = \gamma_H$ the big bank is never worse off as a consequence of the introduction of a reputational effect. Moreover, the expected number of periods in which default occurs is greater than zero (unless initial beliefs are such that the country never challenges the bank). Hence the country's expected payoff is necessarily less than in the nonreputation game. If $\gamma = \gamma_L$, the big bank never is conciliatory. Thus, the country is worse off since each period in which it challenges the big bank, default occurs, occasioning a loss of $\pi_c(\hat{\gamma}_L) + D$.

4. CONCLUSIONS

The experience of the last few years has demonstrated that debt rescheduling negotiations between debtor nations and their creditors are far from smooth. Despite the cost of both parties, the flow of new loans and interest payments have been disrupted regularly. The reluctance of the smaller banks to agree to rescheduling terms and the concern of the large international banks of the effect that the terms of negotiation may have on future negotiations with the same or with other countries has been an important source of the problem.

This paper highlights the role played by the presence of small banks and

asymmetric information in contributing to the existence of a reputational effect and hence permitting rocky negotiations. The principle implication of our analysis is that the country is always made worse off as a consequence of the reputational effect. It also provides a possible explanation for the recent introduction of exit bonds. These long-term, lower interest bonds, targeted at the small banks, would allow the purchaser to be exempt from participation in further rescheduling and lending. The bonds themselves would not be rescheduled, nor would they be included in the base that determines the obligation to provide new money. As shown by our analysis, the elimination of the reputational effect that this would allow makes the country better off. Also, provided that these bonds are not themselves evaluated by the small banks as being too risky, they would also make the small banks better off.

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Customer Satisfaction Incentives

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Customer satisfaction incentive schemes are increasingly common in a variety of industries. We offer explanations as to how and when incenting employees on customer satisfaction is profitable and offer several recommendations for improving upon current practice. Faced with employee groups (including managers) who may have shorter time horizons than the firm, such systems enable a firm to use customer reaction to monitor implicitly how employees allocate effort between the short and long terms. These systems can be used to encourage employees to make tradeoffs that are in the best interests of the firm.

We derive optimal reward systems for an equilibrium in which the firm maximizes profits, employees maximize their expected utility, and customers choose purchase quantities based on initial reputations, employee efforts (both ephemeral and enduring), and price. The formal model shows how the reliance placed on customer satisfaction in an incentive scheme should depend upon the precision with which customer satisfaction is measured and the extent to which employees focus on the short term. Recommendations for improving upon current practice include: measure customers, former customers, and potential customers; measure satisfaction with competitors' products; disaggregate satisfaction to reflect better the performance of employee groups; and, when different customer segments have different switching costs or they vary in the precision with which their satisfaction can be measured, then measure the segments separately and assign different weights in the incentive plan.

Throughout the paper we interpret the formal results based on our experience with actual firms and the current literature. We close with a brief discussion of on-going research at field sites.
(Competitive Strategy; Measurement; Customer Satisfaction; Incentives)

Total Quality, because of its focus on benchmarking customer and consumer satisfaction, is basically an insurance policy for sustaining competitive advantage over the long term.

—Edwin Artzt, Chairman and CEO of Procter & Gamble

We want to give the best customer service of any company in the world. . . . To maintain our reputation for excellent service, we long ago established high standards for the selection of salesmen and customer engineers.

—From Thomas J. Watson, Sr.'s (founder of IBM) business doctrine¹

1. Introduction

Many American corporations include customer satisfaction or quality in their employee motivation systems. In some cases, the rewards are psychological—management believes

¹ The Artzt quote is from Bemowski (1992). The Watson quote is from Watson, Jr. (1963, pp. 29, 30).

that if employees know that customers are satisfied then these employees themselves will be more satisfied and will work more effectively. In some cases, the rewards are implicit. Management believes that, in the long-run, a satisfied customer is an asset of the firm and that this asset makes the firm more profitable. Management communicates this belief to the employees together with the implication that if the firm is more profitable, the employees will remain employed and, perhaps, earn higher wages.

In other cases, employee compensation is tied directly to customer satisfaction or quality measures. Ernst & Young and the American Quality foundation (1992) report a dramatic increase in the percent of U.S., Japanese, German, and Canadian firms for which quality is the most important criterion for senior management compensation (90% increase over the last three years with projections that quality will be the primary criterion in the majority of firms by 1995). Phillips et al. (1990) observe that both GTE and Montgomery Ward compensate management on customer satisfaction and quality measurements. Mercer (1992, p. 11) reports that 76% of the electric and gas utility companies have specific objectives for employees that include customer satisfaction targets and that customer satisfaction incentive compensation schemes are most common in the 25 largest companies. In our own discussions with Fortune 500 firms in both the manufacturing and service sectors, we have found that top management *and* middle management are extremely interested in the effects that customer satisfaction measures have upon profitability. Many are struggling to design profitable customer satisfaction based management and/or compensation programs.

Why all the attention? How does incorporating measures of customer satisfaction into employee incentive systems increase profitability? This paper offers potential explanations as to how and when incenting employees on customer satisfaction can be profitable and suggests several improvements upon current practice. The proposed explanations are that incenting on customer satisfaction *and* sales overcomes short-term foci and provides managers and workers with incentives to make the short-term/long-term tradeoffs that are best for the firm.

We argue all employees (managers, product designers, service providers, production workers, etc.) allocate their effort between actions that influence current period sales and actions that influence sales in future periods. Unfortunately employees are generally more focused on the short term than the firm would like. In response the firm can collect measures that we call "customer satisfaction." The measures we seek represent a (noisy) current period indicator of future profitability and a (noisy) measure of employee effort directed towards the long-term. The greater the reliance on customer satisfaction in determining the size of bonuses, the more effort that employees will be expected to allocate towards improving profit in the long term. Furthermore, to the extent that firms are unable to determine precisely their employees' effort levels (or tradeoffs), customer satisfaction provides a means to encourage profitable tradeoffs without the firm explicitly measuring employee effort.

We begin with a mathematical model of customer, employee, and firm behavior in an environment in which each actor's actions are affected by the decisions of the other actors. The model is based on our experience in developing customer satisfaction programs, interviews with practitioners in both manufacturing and service firms (including many Fortune 500 firms), interviews with market-research suppliers, and a review of the strategy, quality, marketing, and R&D literatures. We derive the model and characterize the optimal incentive schemes, expected (optimal) employee response, customer behavior and the sales, prices, and profits of the firm. We then use the model to understand what influences the measurement and reward system and how we can improve upon existing systems. The results have both descriptive and normative implications—we explain how firms may profit from measuring customer satisfaction and suggest several improvements upon current practice.

2. Relationship with the Literature

We draw from the strategy, quality, marketing, and R&D literature focussing on short-termism and customer satisfaction measures.

In the strategy literature many papers have postulated that (American) corporations have too much of a short-term focus. Managers and workers focus on short-term sales and profit at the expense of long-term profit, discounting future earnings at a higher rate than is optimal for the firm. Indeed this problem is the subject of much popular writing. For example, Wollner (1992) argues, "Consumer shouts for better-quality cars were ignored as prices continued to rise . . . this was an effective short-term strategy with disastrous long-term consequences." The Council on Competitiveness recently sponsored a special report on this issue (Porter 1992). The report offers many explanations for this short-term behavior including labor market imperfections (Becker 1962, Grout 1984), take-over threats (Stein 1988), asymmetric information (Myers 1989, Stein 1989), and commitment problems (Weitzman 1980).

To counter short-termism and to align employee incentives with those of the firm, companies have adopted a number of sophisticated incentive systems. Employees receive bonuses based on stock options, on stock price, on market share, on new customers, on new products, and on other more subjective criteria. However, some systems suffer from severe free-riding problems. For example, while a CEO's actions might have a noticeable impact on stock price, the actions of a single telephone-service representative will be negligible. Presumably, the more directly an employee's actions affect a performance measure, the more responsive employees will be to feedback and incentives based on the measure.

Many papers in the marketing and total-quality-management literatures have focused on the measurement of customer satisfaction. The literature is extensive and diverse. Some papers focus on developing and testing more precise measurement scales while others use these scales and focus on the link from satisfaction (or quality) to future sales, purchase intentions, retention, loyalty, and other surrogates for revenue. Others test intervening variables, explore multiple linkages, and refine the conceptualization of satisfaction in order to develop a causal understanding of satisfaction formation, often in conjunction with behavioral explanations such as expectation-disconfirmation, equity, norms of comparison, and value-prompt disparity. The literature has also seen a normative focus with the development of service-quality measurement systems and barometers that seek to become indicators of firms' (or national economies') performance. In marketing and in the related discipline of total quality management many have argued that satisfaction should be a strategic focus of the firm.

For the reader who wishes to explore these literatures we recommend Anderson and Sullivan (1993), Bearden and Teel (1983), Bolton and Drew (1991a, b), Boulding, Staelin, Kalra, and Zeithaml (1993), Churchill and Surprenant (1982), Cronin and Taylor (1992), Deming (1986, p. 5), Fornell (1992), Fornell, Ryan, and Westbrook (1990), Fornell and Wernerfelt (1988), Fornell and Westbrook (1984), Gale (1992), Hayes (1992), Kordupleski, Rust, and Zahorik (1993), LaBarbera and Mazursky (1983), Oliver (1980), Oliver and DeSarbo (1988), Oliver and Swan (1989), Parasuraman, Zeithaml, and Berry (1988), Rust and Zahorik (1991), Tse and Wilton (1988), Westbrook (1980a, b), Yi (1990), and Zeithaml, Parasuraman, and Berry (1990).

Of course, customer satisfaction measurement is not without its critics. For example, Goodman et al. (1992) argue that customer satisfaction surveys are ineffective if they are not tied to customer behavior. For recent critical reviews see Cronin and Taylor (1992) and Yi (1990).

Naturally, such a diverse literature differs in its definition of customer satisfaction. For example, some researchers use transaction-specific or brand-specific measures while others use measures that indicate an overall customer evaluation of all experiences including

transactions, product use, and service received. Furthermore, some limit satisfaction, by definition, to those products or services that the customer experiences while others broaden the concept to include customers' perceptions of the satisfaction they would have received had they experienced a competitor's product or service. Many in the literature are careful to distinguish satisfaction (post-consumption experience) from quality (a characteristic of the product or service) and from value (a notion of quality net of price). For our purposes we do not define satisfaction explicitly. Instead we define it implicitly (Equations 2 and 3) as a measure that indicates the long-term impact of those actions employees take to influence tomorrow's sales. We recognize that the measure may not be perfect and that other intervening variables, exogenous to the model, such as expectations, norms of comparison, and equity, might or might not influence *measured* satisfaction. This allows us to focus on the managerial use of customer satisfaction measures and allows us to formulate a theory that is consistent with a broad range of the behavioral and measurement literatures. The better the measure, the more powerful it will be as an incentive. However, we are careful to formulate a theory that models noise explicitly so that we might explore the impact of imprecision in the measures.

We build upon the following implicit (and sometimes explicit) premises that pervade the literature:

- customer satisfaction is a multi-period issue—a firm (or its employees) takes actions today that affect purchasing behavior in the future;
- customer satisfaction measures are an indicator of future profit potential (more satisfied customers will buy more, buy more often, buy at a higher price, and/or communicate their satisfaction to others).

Based on these premises we explore the beliefs that can be found in the literature and we examine proposals to improve upon current practice. Some of these beliefs are:

- customer satisfaction measures provide a better management tool if the measures are more precise;
- employees who take or influence actions which affect customer satisfaction should be given feedback and/or incentives to guide their actions; and
- a well-designed customer satisfaction system enhances profits.

We now formulate a model that incorporates these premises and examines these beliefs.

3. A Model of Firm, Employee, and Customer Behavior

To incorporate the multiperiod premise we abstract to a two-period framework where the first period represents "today" and the second period represents the future impact, "tomorrow." The second period need not be of the same duration as "today." We need only that today's actions affect the future in some discounted manner, that is, some of today's employee actions affect customer utility today and some affect customer utility tomorrow. We focus on a focal firm keeping competition implicit.

Yesterday and Today: Customer Response

We assume that customers arrive to the market continuously, thus all of the following discussions of a "customer" refer to the rate of arrival in the interval dc . This is for analytical convenience only. For ease of exposition, we present the definitions in the form of discrete customers.

We assume that the firm has been in the market long enough to develop a goodwill reputation for quality, g . This reputation includes designed-in quality and customer-service characteristics such as a reputation for excellent technical support. Customers vary in their needs and their perceptions of the products, thus the potential reputation, \tilde{g}_c , that any given customer (c) perceives in period 1 is equal to the average reputation, g , plus heterogeneity "error," \tilde{e}_{1c} . That is, $\tilde{g}_c = g + \tilde{e}_{1c}$. For simplicity we assume that

the perceptual variations are independent across periods and customers and are normally distributed with zero mean and positive variance.

Following the total quality management literature, we focus on a group of employees that takes actions together and is rewarded together. For simplicity we assume that the group is motivated properly such that there are no free-riding problems within the group. We focus on the efforts (decisions and actions) of the employee group. (In the final section of the paper we examine characteristics of customer satisfaction measures that might reduce free-riding.)

Some of the effects of that effort are ephemeral—the effort helps to make the sale but does not add to the firm's reputation for quality. For example, high-pressure sales tactics, attempts to serve many customers at once and attempts to sell unnecessary add-ons might be such efforts. We call the component of effort that has short-term impact ephemeral effort (Bennett 1990), and we designate that effort (for customer c) by a_c . Other components of employee efforts have enduring effects. These efforts do not affect the sale today but add to the customers' satisfaction and hence the firm's reputation for "quality." For example, post-purchase explanations of how best to use a product, support on installation, or recommendations on how to maintain the product over its lifetime all have enduring effects. We call such components of effort enduring effort and designate them (for customer c) by b_c . In practice, some employee efforts have components that are both ephemeral and enduring, while some ephemeral actions may actually decrease the enduring reputation of a brand. The employee group need not separate efforts into their ephemeral and enduring components, and the firm need not measure these components. We need only that any given action (or decision) can, in principle, be described as having ephemeral and/or enduring components and that the employee group must make trade-offs between these components. The employee group decides upon actions; our definitions simply help us trace the impact of those actions. A well-designed customer-satisfaction incentive system will motivate the employee group to choose actions such that the allocation of effort between a_c and b_c maximizes the firm's long-term profit.

We interpret employee group broadly. For example, in one firm with which we are working, the employee group consists of managers of telephone representatives; in another firm the employee group is a specialized team that trains retailers on how to use the firm's product to produce the best result for the end customer. Examples of employee groups are interfunctional product-development teams, quality control circles (Lillrank and Kano 1989), sales groups, telephone-service representatives, flight attendants, or brand-management teams.

It is worth noting that a_c and b_c are incremental efforts above and beyond what the employee group would do without incentives. In this way we focus on those efforts that would not occur in the absence of a reward system. The impact of standard efforts on sales are captured by the initial reputations of the firm; the employee group is rewarded for these efforts by a base wage, \bar{U} , for each period.

The firm (endogenously) selects its price in the first period, p_1 , in order to maximize long-term profits. Customers then evaluate the firm's reputation for quality, price, and the ephemeral effort expended by the employee group when deciding how much to purchase.

Let \tilde{q}_{1c} be the quantity the focal firm sells to customer c in period 1, then:²

$$\tilde{q}_{1c} = g + a_c - p_1 + \tilde{e}_{1c}. \quad (1)$$

² We choose the linear demand function in the belief that the qualitative results are unaffected by this choice. While a linear model allows negative sales for some prices, profit maximization prevents this. g , a , and p are measured in monetary units. There is a unity multiplier of quantity/\$ for the right-hand side of the equation in order to make equation (1) consistent in units. Although our focus is on customer satisfaction, we keep prices endogenous to ensure that the results are not eliminated by price movements.

Technically, (1), coupled with the continuous time nature of the model, implies that cumulative sales are given by a Brownian process with drift $E[q_{1c}]$ and variance σ_{1q}^2 .

Tomorrow: Customer Response

Tomorrow's reputation is a function of today's reputation and the enduring effort expended by the employee group. For simplicity we model tomorrow's reputation as $g + b_c + \tilde{e}_{2c}$. The employee group chooses ephemeral and enduring efforts for the first period. In reality, tomorrow will be like today, and the employee group will make both types of efforts. To focus on the short-term vs. long-term tradeoffs, we take the second period as an ending period with no effort. However, the firm does set a profit-maximizing price, p_2 , in period 2. "Today" represents those periods in which the employee group must make tradeoffs between ephemeral and enduring efforts. In reality, the ending period need never actually occur, a firm might face a succession of periods, like "today," in which both ephemeral and enduring efforts occur. The ending period is the most parsimonious manner to examine rewards based on today's enduring effort.

The customer utility function and response in period 2 is analogous to that in period 1. The customer will purchase quantities:

$$\tilde{q}_{2c} = g + b_c - p_2 + \tilde{e}_{2c} \quad (2)$$

and cumulative sales will be a Brownian process with drift $E[q_{2c}]$ and variance σ_{2q}^2 .

The Firm's Measures

It is often too expensive or too difficult for the firm to observe the effort allocated by each employee group to each customer. Even if the firm could do so, it might choose not to because (1) such measures may be viewed as too intrusive or may be proscribed by law and (2) the employee group may have customer-specific knowledge that enables it to make better allocation decisions (as long as the rewards are set appropriately).

We assume the firm can measure sales volume and customer satisfaction. Total customer satisfaction is a measure over customers of the benefit they receive from enduring actions by the employee group. As defined above, a firm's total reputation for quality in period 2 depends both upon its initial reputation and the enduring efforts expended by the employee group. Future sales are related to this measure, but depend upon other variables as indicated by Equation 2. We recognize that customer satisfaction is measured with error. From the firm's perspective this error, \tilde{e}_s , is additive. We assume that the error in aggregate satisfaction is normally distributed with variance σ_s^2 :

$$\tilde{s} = \int_c f(b_c) dc + \tilde{e}_s. \quad (3)$$

The increasing, concave function, $f(\cdot)$, recognizes explicitly that variables exogenous to the model (e.g., expectations, norms of comparison, equity) might intervene between employee effort and the survey measure of customer satisfaction. Specifically, we allow $f(\cdot)$ to have other arguments as long as the arguments do not vary by customer.

Equation (3) is a simple conceptual model. However, for technical reasons³ we need to assume that employees observe both sales and satisfaction measures for one customer

³ We need this technical assumption to avoid the "Mirrlees existence problem" (Mirrlees 1974, Shavell 1979, Innes 1990). An assumption of a normal distribution allows highly negative (but low probability) outcomes. With such negative outcomes the possibility exists to induce any employee behavior with very large fines for very poor outcomes. If employees can observe outcomes as they go along, they can avoid such very large fines by modifying their behavior. An alternative approach would have been to bound the extent to which measured satisfaction can differ from employee expectations by truncating the tail of the error distribution (although this would breach one of the assumptions guaranteeing the optimality of the linear contract).

c before moving on to the next customer. While at first glance this assumption might seem extreme, all we really need is that the employee group is aware of how well they are satisfying customers so that there is a reasonable limit to the disparity that can exist between the expectations of the employee group and measured satisfaction at the end of the period:

$$\bar{s} = \int_c [f(b_c) + \bar{e}_{sc}] dc. \quad (3')$$

Note that we can relate (3') to (3) by recognizing that $\bar{e}_s = \int_c \bar{e}_{sc} dc$.

Because period 2 is an ending period, there is no need in our model for a customer-satisfaction measure in period 2. In practice, there are multiple intermediary periods (weeks, quarters, years) in which both sales quantities and customer satisfaction are measured and in which employees are rewarded on both measures. In our model these intermediary periods are treated as if they were merged into period 1.

The Reward System

To encourage employees to make the tradeoffs that are best for the firm, the firm rewards the employee group based upon the sales-quantity and customer-satisfaction measures. In period 1, the firm pays a reward of $w_1(\bar{q}_1, \bar{s})$. The functional form and the parameters of the function are chosen to maximize profit. In the ending period, period 2, the firm rewards only measured sales quantity; it pays a reward of $w_2(\bar{q}_2)$.

It is convenient to think of w_1 and w_2 as monetary rewards; however, they need not be. Any set of rewards that the employee group values and for which the firm must pay would be appropriate including trips to sales conferences, company picnics, and awards banquets (Feldman 1992). For example, 3M, located in a cold climate, rewards some employees with a close, reserved parking spot. For simplicity we assume that the amount that the firm pays is equal to the amount that the employee group receives. The employees also receive a fixed compensation as remuneration for the minimum effort expended in order to retain employment. We address below whether such compensation affects the structure of the rewards.

The Employees' Motivations

In deciding how to allocate ephemeral and enduring efforts the employees act in their own best interests. For example, one electric utility rewarded its telephone-service operators on the number of calls answered per hour. In some instances they just selected waiting calls and hung up immediately. When the rewards were switched to percent of time that the operator is on-line with a customer, some operators found it rewarding to place customers on hold while taking allowed breaks. This does not make the employees evil; rather it recognizes that the objectives of the firm and the objectives of the employees are often not identical. The telephone operators simply optimized against the incentives that the system provided. It is the firm's responsibility to design an incentive system that results in consistency between the firm's and the employees' objectives so that, when acting in their own best interests, the employees take actions that also benefit the firm (Deming 1986).

Incremental effort is costly to employees and becomes more costly as total effort increases. To model this phenomenon we approximate the employee group's cost of effort using a quadratic cost function. Ephemeral and enduring effort are measured on the same scale—that is, employee costs are $\int [a_c^2 + b_c^2] dc$. In practice, deciding upon the scale with which to measure such efforts is an important decision.

Short-termism implies that employees discount rewards in the second period more than firms. There are a number of reasons why employees discount the future more. Any combination of these reasons is sufficient; all need not apply. In addition to those

set forth in the Council-on-Competitiveness report, we offer the following: (1) The employees may not have a life-time employment contract, thus the employees know that there is some likelihood that they will not be around to collect the rewards. (2) The employees may serve customers well and the customers may come back to the firm, but the employees may not get credit for those customers. For example, consider an employee working in a rest-stop McDonald's on the highway leading to Cape Cod. While it is important to the McDonald's Corporation that rest-stop customers are treated well, it is less important to the employee because repeat business is infrequent. (3) Employees may fear that the firm will change the reward system in the ending period. Finally, (4) the firm may have access to a capital market that allows it to borrow at a better rate than employees. To capture these effects we normalize the discount factor of the firm to 1.0 and assign a positive discount factor of $\delta < 1$ to the employee group.

The employee group must deal with uncertainty in how enduring efforts affect customer satisfaction and with uncertainty in sales volume "today" and "tomorrow." Because of this uncertainty we must model employee risk preference. We do so with a von Neumann-Morgenstern utility function that exhibits constant absolute risk aversion.⁴ Such functions have proven to be good approximations in a variety of fields.⁵ In terms of a reward system, constant absolute risk aversion implies that the employees' reactions to w_1 and w_2 do not depend upon the fixed salary.

Putting all of these arguments together, the employees maximize incremental utility, $U(\cdot)$, given by equation 4 where r is the measure of risk-aversion:

$$U(\cdot) = 1 - e^{-r(w_1 + \delta w_2 - \int [a_c^2 + b_c^2] dc)} \quad (4)$$

Recall that the rewards based on sales quantity and customer satisfaction are above and beyond the base compensation for normal efforts in the two periods of the employment agreement. The employees have the opportunity to work for other employers or not to work at all. They only will work if the expected compensation net of effort and risk costs is valued at least at $(1 + \delta)\bar{U}$ for the two periods. Similarly, the employees may choose to quit at any time in which case they receive compensation less than their accumulated effort costs for the period in which they quit. If they quit before the second period begins they receive compensation, \bar{U}' , which is less than \bar{U} .

Faced with reward systems w_1 and w_2 , the employee group seeks to maximize $U(\cdot)$ by choosing efforts, a_c and b_c , for each customer.

The Firm's Objective

Finally, the firm chooses the reward system to maximize its total expected profits ($\bar{\cdot}$ indicates expected value): $\pi = p_1\bar{q}_1 + p_2\bar{q}_2 - \bar{w}_1 - \bar{w}_2$. Recall that the firm's discount rate is normalized to one. We have also assumed that costs are zero with little loss of generality (prices may be thought of as margins).

Summary

The following actions summarize the formal model:

- Both the firm and the employee group observe initial reputations.
- The firm announces prices and reward systems for both periods.
- As customers arrive sequentially and continuously during the first period, the employee group allocates both ephemeral and enduring efforts to each customer (max-

⁴ Employees are constantly risk averse if the choices among risky alternatives do not depend upon changes in their wealth. Constant absolute risk aversion implies negative exponential utility. See Keeney and Raiffa (1976, p. 167).

⁵ See Currim and Sarin (1984), Eliashberg (1980), Farquhar (1977), Hauser and Urban (1979), and Roberts and Urban (1988) for empirical applications and tests. See Lilien, Kotler, and Moorthy (1992, pp. 14-15) for a review of applications to salesforce compensation.

imizing expected employee utility). Based on these efforts, the initial reputation, and the price, the customers purchase the amount of the product that is best for them. While the enduring efforts do not affect the value of the product in period 1, customers do observe the result of these efforts (after purchasing the product) and these efforts do affect purchasing in period 2. The employee group observes a customer's sales and satisfaction.

- The employee group may adjust both ephemeral and enduring efforts at any time during the period, perhaps based upon the outcomes (sales and/or satisfaction) from previous customers.
- At the end of the first period, the firm measures sales volume and customer satisfaction and rewards the employee group accordingly.
- In the second period, customers return to the market and make decisions based upon the firm's reputation and the employee group's enduring efforts. The customers buy the quantity that is best for them.
- The firm measures second period sales quantity and pays employees accordingly.

4. Optimal Behavior and Equilibrium

We focus on that component of customer satisfaction that is an indicator of enduring employee effort. We do this by setting $f(\cdot)$ to the identity function. (A more general $f(\cdot)$ complicates the proofs but does not change the conceptual results.) Without loss of generality we normalize g to 1.0.

Optimal Contracts Are Linear, Optimal Employee Behavior Is Constant Effort

In principal, the firm's reward system could depend upon the complete history of sales and satisfaction. Fortunately, our mathematical formulation implies constant effort for two reasons. First, because the employee group reacts to uncertainty independently of wealth (constantly risk averse utility), any previous losses or gains are irrelevant. Second, because the marginal cost of effort is not a function of total effort in the period, it can be viewed as a separable sum (integral) across customers. Thus, the reward system can be written as a sum of the rewards for the observed outcomes (sales and satisfaction) for each customer (Holmstrom and Milgrom [HM] 1987, theorem 4). Furthermore, wealth independence and the concavity of the cost function imply that the optimal actions are constant over time, that is, $a_c^* = a^*$ and $b_c = b^*$ for all customers c (HM, theorem 5) where $*$ indicates optimal. By a change of variables, an optimal reward system is then a linear combination of "account balances" (HM, theorem 7). In our case, the account balances are the sales quantities and *total* satisfaction (summed across customers).

These results greatly simplify the analytical burden of our model. While the exact linearity of the reward system depends upon the technical assumptions, linearity is a good approximation to a variety of reward systems. More importantly, this result is consistent with the principle of simplicity that pervades the total-quality-management literature (Deming 1986, chapter 11; Lillrank and Kano 1989, p. 22). By matching the analytical model to current practice and intuition, we are able to investigate the implications of changes in the values of parameters such as the precision of the measurements or the relative magnitudes of the firm's and the employees' discount factors. Many concepts from the formal agency theory literature become immediately available and relevant to the customer-satisfaction literature clarifying debates that pervade management practice, academic literature, and the popular press.

Equilibrium—Customers, Employees, and the Firm

Based on our discussions with both managers and employee groups attempting to implement customer satisfaction systems, it is reasonable to assume that the employee

group chooses its effort allocation, a^* and b^* , based on the prices and reward systems chosen by the firm, p^* and w^* . (p and w are shorthand notations for the vectors $\{p_1, p_2\}$ and $\{w_1, w_2\}$, respectively.) In turn, the firm selects its best price based on the reward system, where the reward system implies employee efforts and the resulting demand curves. Analytically, we first find the employees' optimal efforts based on a candidate set of prices and rewards. We then find the firm's optimal price based on a candidate set of rewards. Finally, the firm selects the parameters of the reward function to maximize profit.

We begin with a candidate set of rewards, \hat{w} . By linearity and constancy, we can write the candidate reward functions as:

$$\hat{w}_1 = \alpha_1 + \beta_1 \bar{q}_1 + \eta \bar{s}, \quad \hat{w}_2 = \alpha_2 + \beta_2 \bar{q}_2. \quad (5)$$

Because the employee group's utility function is constantly risk averse and the uncertainty is normally distributed, the certainty equivalent, *c.e.*, is equal to the mean utility minus a risk premium ($r/2$ times the variance). Rearranging terms yields:

$$\begin{aligned} c.e. = & (\alpha_1 + \delta \alpha_2) + (\beta_1 \bar{q}_1 + \delta \beta_2 \bar{q}_2) + \eta \bar{s} - (a^2 + b^2) \\ & - (r/2)(\beta_1^2 \sigma_{1q}^2 + \eta^2 \sigma_s^2 + \delta^2 \beta_2^2 \sigma_{2q}^2). \end{aligned} \quad (6)$$

Maximizing this, using (1) and (2), gives

$$a^*(\hat{w}) = \beta_1/2, \quad b^*(\hat{w}) = \delta \beta_2/2 + \eta/2. \quad (7)$$

Note that these effort levels are independent of prices.⁶

To ensure employee participation, the rewards that the firm must pay should at least compensate employees for both the incremental costs incurred and the risk undertaken. Therefore, the expected incremental rewards, beyond $2\bar{U}$, that the firm must pay must be valued in both periods by employees as sufficient to compensate them for costs and risk. That is:

$$\begin{aligned} E[\hat{w}_1] + \delta E[\hat{w}_2] &= \hat{a}^2 + \hat{b}^2 + (r/2)(\beta_1^2 \sigma_{1q}^2 + \eta^2 \sigma_s^2 + \delta^2 \beta_2^2 \sigma_{2q}^2), \\ E[\hat{w}_2] &= (r/2)\beta_2^2 \sigma_{2q}^2. \end{aligned} \quad (8)$$

Note that equation (5) allows us to adjust α_1 and α_2 so that employees receive an expected net salary which they value as $(1 + \delta)\bar{U}$ for the two periods and \bar{U}' in the second period.

Given these rewards (and the conditions set forth), the firm maximizes expected profits,

$$\pi = p_1 \bar{q}_1 + p_2 \bar{q}_2 - E[\hat{w}_1] - E[\hat{w}_2],$$

by substituting in equations (1), (2), (5), (7), and (8), and solving for the equilibrium prices and rewards:

$$\begin{aligned} \pi = & p_1(1 + \beta_1/2 - p_1) + p_2(1 + \delta \beta_2/2 + \eta/2 - p_2) \\ & - \{E[\hat{w}_1] + \delta E[\hat{w}_2]\} - (1 - \delta)E[\hat{w}_2]. \end{aligned} \quad (9)$$

We select rewards to assure the employee group chooses to remain employed in both periods.

Finding the optimal reward parameters is now a matter of calculus—substituting, differentiating with respect to the parameters of interest, setting the derivatives equal to zero, and solving simultaneously.

⁶ In general, the candidate prices influence efforts because the marginal sales quantities are a function of prices. If the implied efforts were a function of price, profit maximization would need to take this into account. However, in our case the linearity of rewards and demand assures that the cross partials, e.g., $\partial^2 q_i / \partial p_j \partial a$, vanish. Furthermore, the variances, and hence the risk, are not a function of price. If the cross partials did not vanish, the same basic calculations would apply, but the algebra would be more complex.

5. What Affects the Reward System?

We begin with the question of whether a firm has incentives to institute a customer satisfaction incentive system. That is, are such systems profitable? We then probe how employee characteristics affect incentive systems. For example, if employees are more future-oriented, how would this affect the weight that a firm should place on customer satisfaction? We also examine how the precision of satisfaction measures affects the reward system. Our method of analysis is straightforward but tedious. After solving implicitly for the optimal rewards, prices, and profits, we use the implicit function theorem and the envelope theorem to determine how the optimal contracts change as functions of the parameters. We state the results in the text, but the proofs are in the appendix.

Do Firms Have Incentives to Include Measures of Customer-Satisfaction in Reward Systems?

PROPOSITION 1. *If satisfaction can be measured costlessly, the firm earns incremental profits by rewarding on sales quantity and customer satisfaction as opposed to just sales quantity.*

Proposition 1 reflects the fact that a customer satisfaction system gives the firm more options and that the firm finds it in its interest to use these options. Customer satisfaction enables the firm to reward enduring efforts now rather than later and customer satisfaction carries information about enduring efforts.

To understand the proposition suppose that the firm rewarded on sales alone. Then the employee group would discount the future more and, from the firm's perspective, ignore the long-term implications of its actions. We have seen examples where employees facing strong sales pressure focused on selling business rather than servicing clients. On the other hand, if the firm puts too much emphasis on customer satisfaction, employees might sacrifice profit potential. For example, the head of customer service at a major airline reported to us that when the airline put too much customer satisfaction pressure on gate employees, they gave out free-flight vouchers with too little concern for future revenue implications.

Employee short-termism is only one explanation for the profitability of customer satisfaction. The proof for Proposition 1 survives even when $\delta = 1$ because customer satisfaction provides an additional measure of the employee group's enduring effort; the firm uses this information to reward the employee group. This measure augments the information that the firm obtains (tomorrow) from tomorrow's sales.

Proposition 1 says simply that it is possible to select parameters for the reward functions such that the resulting increase in (net) revenue exceeds the cost of the rewards. It is an empirical question whether the increase in profit justifies the cost of measuring satisfaction. However, given the growing popularity of customer-satisfaction programs and the willingness of firms to continue programs once they have begun, we suspect that the increased profit exceeds the measurement cost in at least some instances.

Do Changes in the Short-Term Focus of Employees Affect the Reward System?

We recall discussions with the head of the power-train division of a major automobile manufacturer and with the president of one of the leading consumer-packaged goods firms. Both managers felt that part of their job description was to help set policies that affected the education and attitudes of the work force. A short-term perspective is one such attitude.

PROPOSITION 2. *If the employee group values the future more (δ is larger), then the firm needs to reward less on customer satisfaction when maximizing profit.*

It is a common belief that American workers are less future-oriented than workers in other countries. If this is true, then Proposition 2 suggests that American firms can counteract short-termism if they place greater reliance on satisfaction in their employee incentives.

For example, if lifetime employment or employee empowerment increases δ , then Proposition 2 suggests that the firm would need to reward less on customer satisfaction. Besides lifetime employment, there are many actions a firm can take to affect how employees value the future. A strong corporate culture that respects employees might encourage them to act in the firm's best interests because they believe they will share in the long-term rewards. For example, Thomas J. Watson's first credo was "our respect for the individual." (Watson 1963, p. 13). Watson (p. 32) reports that "more than one branch manager has worked overnight in his shirtsleeves to help get a customer's salary checks out on time." 3M's *intrepreneurship* program (Katauskas 1990, Mitsch 1990) makes research grants available to employees, encourages them to spend 15% of their time on personal research projects and sets up the successful innovator with a new-product team. In a visit to 3M the head of R&D described to us how 3M uses a variety of awards (including lifetime achievement awards) to tie employees to 3M. Procter & Gamble evaluates managers on profit, volume, and *people* (Barlett 1989). When determining annual raises at least one major university weights course ratings more for untenured faculty than they do for tenured faculty.⁷ These techniques all encourage employees to focus on the future.

Does Better Measurement Lead to More Profits?

An advantage of the formal model is that it clarifies how improved satisfaction measures and better behavioral understanding of these measures affect profits. Intuitively we expect that precision increases a firm's ability to use customer-satisfaction information. Formally,

PROPOSITION 3. *If satisfaction is measured with greater precision (decreased σ_s^2), then (a) the firm should place a greater weight on measured satisfaction and (b) the firm earns higher profits.*

Proposition 3 reflects the fact that one can reward risk-averse employees more heavily on more precise measures since this exposes them to lower risk costs. Proposition 3 explains some of the efforts over the past few years by both academics and practitioners to obtain more precise measures. Furthermore, by understanding better the causal structure and the intervening variables researchers can specify the function, $f(\cdot)$, more precisely so that satisfaction measures serve their dual role (in our model) of indicating future sales potential (Equation 2) and indicating the amount of enduring effort that employees allocate (Equation 3).

To get an idea of current levels of precision, we analyzed data that are used by a major financial services firm in their customer-satisfaction system. In this data, customer satisfaction correlated significantly (0.01 level) with the change in purchase intentions, but the correlation was not perfect (0.22 for satisfaction with the financial services representative, 0.33 for satisfaction with the firm, and 0.28 for overall satisfaction). In personal correspondence, Eugene Anderson and Claes Fornell report comparable numbers for the Swedish satisfaction barometer. We want to emphasize that Proposition 3 deals with the benefits rather than the costs of increased precision. When improved methods and better theoretical understanding of customer-satisfaction measures improve precision without increasing measurement costs, then Proposition 3 quantifies the value that firms obtain from academic efforts. When increased precision comes from methods with significant marginal costs, such as increased samples sizes, then it is an empirical question as to

⁷ Personal correspondence from an anonymous colleague.

whether the increased costs are justified. Our model provides a formal method to evaluate questions such as the optimal sample size, but specific answers depend upon estimated parameters.

Summary

If measured customer satisfaction is an indicator of employee efforts which generate future sales, then the firm is more profitable if it rewards employees based on customer satisfaction. When firms are attempting to maximize profits a greater weight should be placed on customer satisfaction when:

- employees are more short-term oriented, and
- customer satisfaction is measured more precisely.

6. Pitfalls and Remedies

In this section we use the formal model to suggest changes to current practice and/or to clarify debated issues.

Xerox (Menezes 1991) asks 40,000 customers each month how satisfied they are with the products and services that Xerox provides; *Consumer Reports* bases automobile repair ratings on the averages over consumers who own those cars; *PC Magazine* (May 26, 1992) reports service and reliability ratings for personal computer vendors while acknowledging (p. 114) that “machines based on new CPUs [technologies] did better than machines based on older technologies.” (This biases ratings in favor of newer entrants who have an installed base of only later-technology machines.) Even in our own course evaluations we measure those students who have selected to take our elective courses. Each of these examples places weight only on a firm’s customers, not on those potential customers who considered the firm’s products or services and rejected them or on customers who no longer do business with the firm. In contrast, we have seen proprietary examples in both the manufacturing and service sectors where firms measure both their own customers’ satisfaction and the satisfaction that customers of their competitors perceive they would have had had they purchased the focal firm’s product or service. Which practice is right—limiting the definition of satisfaction to the focal firm’s customers or broadening it to include the potential satisfaction of non-customers?

Should Non-Customers Be Measured?

One argument in favor of measuring non-customers is that limiting the sample to current customers introduces a *selection* bias into the measures. If there is a positive relationship between customer satisfaction and likelihood of purchasing, measuring only the satisfaction of current customers will positively bias the measures; satisfaction scores will be large if the firm serves well a niche of customers with like tastes. For example, Fornell (1992) and Griffin and Hauser (1993) report that small niche brands tend to have larger average satisfaction scores (when satisfaction is measured only among the firm’s own customers), while large market-leader brands tend to have lower scores. Both authors hypothesize that this is a result of larger-share brands serving a more heterogeneous market while the niche brands serve a more homogeneous market.

A related argument concerns the use of sample averages rather than total satisfaction.⁸ Employees might avoid serving new customers who are difficult to satisfy if they know that the new customer will lower their average satisfaction score. Indeed, one service manager told us that the best way to improve average satisfaction is to get rid of dissatisfied customers. This averaging effect applies only when non-customers are ignored. If

⁸ One might approximate total satisfaction with volume-weighted scores, i.e., scores proportional to sales volume times the sample average.

customers and non-customers are measured, total satisfaction differs from the sample average only by a constant scaler.

The argument against measuring non-customers is that customers can be measured more precisely—they are easier to locate and have more experience upon which to base evaluations. Non-customers have perceptions, not experience, and lost customers have experience that is out of date. This argument is consistent with research on expertise (Alba and Hutchison 1987) and consideration-set measurement (Howard and Sheth 1969, Silk and Urban 1978). Because reductions in precision lower profitability (Proposition 3), some firms and market research suppliers appear to believe that the cost of reducing precision exceeds the benefit of reducing selection bias.

We now analyze this issue with the formal model.

In equation (3) satisfaction, \tilde{s} , represents the aggregate satisfaction of customers summed over all customers including those to whom the firm sells and those who choose competitive products and services. For analytical simplicity our model is continuous; all customers buy, but in varying amounts. To capture the notion of “*the firm’s customers*,” we replace that measure with an average over only those customers who purchase above a certain amount of the focal firm’s product. We denote this set by q_f and call the new average satisfaction measure \tilde{s}_a . We assume customers in the complement set (to q_f) satisfy their needs with competitors’ products and services. Specifically⁹ ($|q_f|$ is the measure of q_f):

$$\tilde{s}_a = \frac{1}{|q_f|} \int_{c \in q_f} b_c dc + \tilde{\epsilon}_a. \quad (10)$$

PROPOSITION 4. *If satisfaction, averaged over just the firm’s customers, is used in the linear reward rather than total satisfaction for the firm’s customers summed across all of the customers in the market then (a) sales volume and total satisfaction decline, and (b) the firm earns less profit.*

The intuition behind Proposition 4 is that satisfaction, averaged over only customers, distorts the reward system and the employees’ allocations of effort. The employees find it attractive to allocate more effort to relatively few customers. In fact, if there were no weight at all on sales volume and measurement variance was independent of sample size, then all of the employees’ efforts would be allocated to only one customer. This reduction in the number of customers degrades profit. Note that Proposition 4 is more than a statistical sampling result. Proposition 4 suggests that the “wrong” measures cause the employee group to distort their effort allocations thus causing the firm to earn less profit.

Let us now examine the precision argument. Current practice seems to be either to ignore non-customers or to treat customers and non-customers alike. The formal model suggests that we can improve current practice by weighting customers and non-customers differently.

To keep the analysis simple we consider an ex ante segmentation into “customers” and “non-customers.” Let \tilde{s}_c be satisfaction as measured over the firm’s customers and let \tilde{s}_n be satisfaction (with the focal firm) as measured over non-customers (i.e., the competitors’ customers). Let σ_c^2 and σ_n^2 be the corresponding variances. If the firm’s customers’ satisfaction can be measured more precisely, then we have the following relationships among the measurement variances:

$$\sigma_c^2 < \sigma_s^2 < \sigma_n^2, \quad \sigma_s^2 = |q_f| \sigma_c^2 + (1 - |q_f|) \sigma_n^2. \quad (11)$$

PROPOSITION 5. *Given a segmentation into customers and non-customers, if the firm can measure the satisfaction of its customers more precisely than it can measure the*

⁹ Technically, we allow the employee group to observe \tilde{s}_a after each customer producing an equation (10’) analogous to (3’).

satisfaction of non-customers, and if it rewards differentially on the two measures, then (a) the weight placed on satisfaction of customers is greater than the weight placed on non-customers, (b) a non-zero weight is placed on non-customer satisfaction, and (c) profits improve.

Proposition 5 is important because it suggests that current practice can be improved. However, we know of no firms that reward differentially on the two measures. Note that Proposition 5 differs from Proposition 4 because it addresses explicitly the precision of the measures rather than any misallocation of effort that results from the wrong measure. The difference may be subtle, but as the propositions suggest, it is possible to improve firm profits.

Should All Customers Be Treated Equally?

Even if we consider only the firm's customers it is not clear that we should reward efforts to all customers equally. Consider three *WordPerfect* customers. Aleksas is very satisfied with *WordPerfect* and is unlikely to switch. Bjorn is less satisfied with *WordPerfect* and believes he would be more satisfied with *Microsoft Word*—he might switch if the relative level of service provided by *WordPerfect* or *Word* changes. Jody is a dissatisfied *WordPerfect* user who has switched to *Word*—it would take a tremendous effort to switch her back to *WordPerfect*. Clearly, the marginal returns to *WordPerfect* for providing Bjorn with superior service exceeds the marginal returns for providing Aleksas and Jody with superior service. This does not imply that it is optimal to ignore Aleksas or Jody, rather, we should design an incentive system to reflect the different marginal returns to employee effort directed at different customer groups.

It is common practice to use *top-box* reward systems, which reward employees based on the number (or proportion) of customers who responded with the highest possible satisfaction ratings. Such systems reward service to Aleksas but not to Bjorn or Jody. Another common practice is to penalize only the *bottom box*. For example, Xerox has as its goal for 1993 that 100% of its customers be at least "somewhat satisfied" (Menezes 1991). Such systems reward service to Jody but not to Bjorn or Aleksas. Both *top box* and *bottom box* reward systems adopt strategies which overlook the relative switching probabilities and the consequent marginal returns to effort. More formally,

PROPOSITION 6. *If customers can be segmented by the marginal effort it takes to attract or retain them, then the firm can improve its profits by using a weighted, rather than unweighted, satisfaction score.*

A particularly stark example of this occurs when some customers are tied to a firm by switching costs. (For example, see Borenstein 1991 and Weiss and Anderson 1992.) We model switching costs by assuming that $\ell < 1$ customers are tied to the firm while $1 - \ell$ are not.

PROPOSITION 7. *If customers can be segmented by switching costs, then (a) the firm can improve its profits by placing different weights on the sales and satisfaction of customers with different switching costs, and (b) satisfaction receives the highest weight when the absolute values of the switching costs are small.*

The intuition behind Proposition 7 is simple. If switching costs vary, then there are greater returns to having employees focus on the customers who can be induced to switch more easily. This is true whether a priori the switching costs favor or hurt the focal firm. For such an incentive system to work, however, the employees must be able to identify the status of each customer and to disaggregate effort to customer segments.

Proposition 7 is important because it supports our intuition that the incentive system should focus on customers that are more likely to be affected by employee effort. Existing

practice may be improved by investigating customer switching costs when designing incentive systems.

Should We Measure Satisfaction with Competitors' Products?

Puritan-Bennett's spirometry division satisfied their current customers, large clinics and hospitals, quite well. (Spirometers measure lung capacity.) But in 1990 a competitor, Welch-Allyn, introduced a product that better satisfied the needs of general practitioners. Customers were satisfied with Puritan-Bennett's product, but general practitioners were more satisfied with the Welch-Allyn product. Once the opportunity was identified Puritan-Bennett responded quickly with an improved product that satisfied both their current customers and the potential general practitioner market. The product increased total sales five-fold (Hauser 1993).

The American Society of Quality Control suggests that approximately half of the corporate boards surveyed evaluate management performance with *relative* customer satisfaction (Ryan 1992). One reason might be that relative satisfaction (focal firm vs. competition) might be a better indicator of tomorrow's sales. For example, Griffin and Hauser (1993) report that satisfaction with the focal firm's product alone had negligible correlation with sales. When satisfaction with the firm's product versus the competitors' products was considered the correlation with sales exceeded 0.80.

Another reason, which we can explore here, is that measuring the customer satisfaction of competitive products might help a focal firm understand better those components of satisfaction that are related to employee effort versus those aspects of satisfaction that are related to changes in the industry. Define measures, \tilde{s} for the focal firm and \tilde{S} for the competitors or a non-equivalent benchmark (Vaziri 1992). These measures might have a positive correlation that is not related to employee efforts. For example, new technologies or process improvements enable every firm to provide improved products and services. We have also seen negative correlations, in part, because customers' perceptions of customer satisfaction are themselves relative. Customer satisfaction with a product depends upon the industry standards or the relative performance of alternative product offerings. An increase in satisfaction with a competitor's product might reduce satisfaction with the focal firm's offering.

When \tilde{s} and \tilde{S} are correlated, it is possible to use \tilde{S} to obtain more precise measures of the effort levels performed by the focal firm's employees (Holmstrom 1979). Suppose that we reward based on satisfaction relative to a competitor: $\tilde{s} - \zeta\tilde{S}$. We again use the impact of information in the reward system to derive the following practical result.

PROPOSITION 8. *If satisfaction with the competitor's product can be measured costlessly, it should be incorporated into the incentive system whenever the correlation between the measures, \tilde{s} and \tilde{S} , is non-zero.*

Naturally, the optimal weight, ζ^* , depends upon solving simultaneously the full first-order conditions. However, to understand the intuition of Proposition 8, suppose that ρ represents the correlation between the satisfaction measures, then the variance of the relative measure is $\sigma_s^2(1 + \zeta^2 - 2\rho\zeta)$. The precision will increase (variance decrease) whenever ρ and ζ are of the same sign and $|\zeta| < 2|\rho|$. A smaller correlation means a weaker signal implying a smaller weight for competitive satisfaction.

Should All Employees Be Measured Against the Same Index?

Efficient-market theory suggests that a firm should be valued by its stock price and that the market ensures that the stock price contains all publicly available information about the long-term value of the firm. If this is true, any action that raises the stock price should be in the interests of the firm. Hence, if employees own sufficient stock, then one might argue that all of their actions should be consistent with the interests of the firm.

Because employees share the costs and rewards of their actions, self-monitoring and mutual monitoring should develop (Russell 1985). Indeed, corporations such as Avis, Du Pont, Pepsico, Polaroid, and Wendy's each have extensive employee-ownership programs¹⁰ designed to provide such motivation (Scholes and Wolfson 1990). Employee stock ownership plans (ESOPs) are now in place at more than 11,000 companies covering 11.5 million employees (Rosen 1990). Results have been mixed. The U.S. General Accounting Office reports that employee ownership combined with employee participation and management commitment has had a positive impact on performance in some cases but not in others (Klein and Hall 1988, Rosen 1990).

While stock-based measures contain information about the effectiveness of the top corporate officers, they are much less informative about other employees (Scholes and Wolfson 1990). In a \$2 billion company, there is very little a single assembly-line employee can do that will have a noticeable positive impact on the stock price. Indeed, personal agendas will be much more salient to the employee than any stock-price impact. Because such employees benefit from the actions of other employees without taking (costly) actions themselves, the stock-price incentive may not be sufficient to encourage employees to make personal sacrifices. For example, members of a software development group at a major computer company told us that they were rewarded based on customers' satisfaction with the entire computer system. They felt that since they had such a relatively small impact on the overall computer system, the measures had little impact on their behavior and simply introduced more uncertainty into their incentive systems. That firm is in the process of developing measures that can be disaggregated so that the link between the satisfaction measure and employee effort is stronger.

In our analysis customer satisfaction is an indicator of employee effort directed at improving future sales potential. If satisfaction is a better indicator of an employee group's enduring efforts, then the noise in the model, σ_s^2 , is smaller, implying that more weight should be placed on customer satisfaction (Proposition 3). Thus, if satisfaction can be disaggregated so that it relates better to an employee group's enduring efforts, then we have the following result.

COROLLARY. *If the firm uses disaggregate measures of satisfaction, matched to the enduring efforts of each employee, to enhance precision (reduce σ_s^2) relative to aggregate measures, the firm (a) will weight the disaggregate measures more than it would have weighted the aggregate measure and (b) profits will increase.*

In the field, we have observed that a number of firms use methods such as the House of Quality and the voice of the customer (Hauser and Clausing 1988, Roberts 1992) to develop customer-need-specific measures of satisfaction that can be linked to the efforts of employee groups. See McLaurin and Bell (1993) for an example at Weyerhaeuser.

Summary

Our formal analysis justifies some existing (but not universal) practices and suggests new ones. Specifically, customer satisfaction measures are more effective and profitable if:

- customers *and* non-customers (potential customers, past customers, and competitors' customers) are measured,
- the difference in measurement precision for customers and non-customers is reflected in the reward functions,
- greater weight is given to customers with lower switching costs,

¹⁰ Avis is 100% employee-owned and advertises that employee-owners work harder to meet customer needs; Pepsico and Wendy's allocate 10% of an employee's pay in options; 20% of Polaroid's stock is owned by its employees; Du Pont gave every employee 100 shares.

- *relative* satisfaction (satisfaction with our product vs. that with competitors' products) is measured, and
- satisfaction measures are disaggregated to reflect better the impact of each employee's enduring actions.

The actual costs of the measures, their relative precision, and their actual correlations are necessary to address questions such as how many customer segments, what sample sizes, and what level of disaggregation is optimal.

7. Summary, Future Directions, and Implications for Field Research

Many firms now use or are considering systems in which promotion, awards, or compensation depend upon measures of customer satisfaction (or quality). Furthermore, much research in a variety of literatures focuses on the tradeoffs that managers and workers make between short-term (ephemeral) actions and decisions and long-term (enduring) actions and decisions. In this paper we seek to provide a formal structure to explore some of these issues.

In particular, we define enduring effort as that component of actions and decisions that affects long-term sales, and we define satisfaction (or quality) as that measure which is an indicator of the amount of enduring effort that is expended. We recognize explicitly that such measures are noisy, and we address the implications of that noise. Using well-established premises and a simple model that isolates the essential phenomena, we provide an explanation of why customer satisfaction incentive systems enhance long-term profits. Our propositions suggest that well-designed systems provide the right signals to employee groups so that employee groups, acting in their own best interests, make the tradeoffs among ephemeral and enduring efforts that are in the long-term interests of the firm. On the other hand, poorly-designed systems decrease long-term profits. We use the model to explore current practice and to suggest improvements. We also demonstrate how the model can be used to explore the interaction of customer satisfaction incentive systems with other management issues such as life-time employment and employee empowerment.

Only formal extensions can establish the true generality of our analyses. Extensions to different demand and cost functions, s-shaped effort-to-satisfaction mappings, other forms of risk aversion, oligopolies, and heterogeneity that is not independent across periods each provide interesting technical challenges. Some of these can be analyzed in the context of the optimal linear contracts used here. Others may need to use linear contracts as robust approximations to optimal non-linear contracts. Explicit consideration of intervening variables such as expectations and explicit modeling of more complex causal structures should prove fruitful. Satisfaction measures have been evaluated as indicators of future sales potential; such measurement research might be extended to explore satisfaction as an indicator of enduring efforts.

Our corollary suggests that when satisfaction measures are disaggregated properly to employee groups, satisfaction incentives reduce the free-riding problems inherent in ESOPs and in incentive systems based on aggregate satisfaction. However, some free-riding problems may still exist within or between employee groups. We have only begun to address this problem.

The mathematical structure might also apply to other relationships where repeat business is important to profit but the enduring efforts of an agent are not readily observable. For example, franchisors might provide incentives to franchisees, manufacturers to distributors and retailers, and parent companies to subsidiaries. Naturally, any analysis would be modified to address specific issues that arise in these relationships.

Another challenge is the notion of an internal customer. Many firms reward upstream employees for satisfying downstream employees, presumably as surrogates for the final customer. While our structure begins to address this issue, it does not take into account

potential distortions due to gainsharing between upstream and downstream employees nor does it take into account benefits to the downstream employees that are not in the interest of the firm. We are currently investigating incentive systems to address this problem. Under the proposed incentive system, internal customers would make an interim selection from a menu of contracts after observing the efforts of the upstream employees. In doing so, they signal the level of enduring effort expended by those employees. Upstream employees are then rewarded based on this signal.

Perhaps the most interesting extensions are empirical. We have made a number of recommendations for practice. These remain to be tested. It would also be useful to have a census of current practice. We predict that customer satisfaction systems can be profitable if the enhanced profit exceeds measurement costs. Comparisons of a firm's satisfaction asset versus the firm's value (stock price) could yield insight on this hypothesis.

Aspects of our theory have been applied at both a financial-services firm and a \$2 billion manufacturing firm. At the financial-services firm a team of telephone representatives has been identified and trained to service a set of profitable accounts. While the employees do not receive explicit customer satisfaction bonuses, customer satisfaction measures influence evaluations. Both sets of measures are relative, include customers and non-customers, and are disaggregated through voice-of-the-customer analyses. The firm will track effort allocations, sales, revenue, profits, and other measures. At the manufacturing firm two test/control quasi-experiments are underway—one in the U.S. and one in Europe. In the test cells a set of employees have been trained to undertake tasks directed at improving customer satisfaction. Effort allocations, sales, reservation prices, revenues, profits, and other measures are being tracked. The measures are relative, include customers and non-customers, and are disaggregated. To uncover the longer-term impacts of the proposed reward systems, one would have to track these measures over time.^{11,12}

¹¹ Ronit Bodner (MIT) analyzed the initial data from the financial services firm and suggested numerous references. Funding was provided by the International Center for Research on the Management of Technology. We benefitted from comments by our MIT colleagues and the member companies. Our thanks to managers at the unnamed financial services firm and the manufacturing firm, to managers at a number of Fortune 500 firms, and to professionals at a number of market research and quality consulting firms for providing us with insight on corporate practice. Earlier versions of this paper were presented at the TIMS Marketing Science Conference in London, the ORSA/TIMS Conference in San Francisco, the ICRMOT pro-seminar series, the MIT Marketing Group Workshop, the AMA Educators' Conference (Executive Program) in Boston, the University of Florida's Winter Retreat, and internal seminars at member companies and at consulting firms. Eric Anderson, Eugene Anderson, Claes Fornell, Josef Mazanec, Roland Rust, Hermann Simon, the Area Editor, and two anonymous reviewers each provided detailed comments on earlier drafts. Cover art copyright, New Vision Technologies, Inc.

¹² This paper was received March 1993 and has been with the authors 5 months for 2 revisions. Processed by Robert Meyer, Area Editor.

Appendix: Proofs of Propositions 1–7

Profit Equation. By substituting (7), $p_1^* = (2 + \beta_1)/4$, and $p_2^* = [2 + \eta + \delta\beta_2]/4$ into $\pi = p_1\bar{q}_1 + p_2\bar{q}_2 - \bar{w}_1 - \bar{w}_2$ we get:

$$\begin{aligned} \pi = & \left[\frac{2 + \beta_1}{4} \right]^2 + \left[\frac{2 + \eta + \delta\beta_2}{4} \right]^2 - \left[\frac{\beta_1}{2} \right]^2 - \left[\frac{\delta\beta_2 + \eta}{2} \right]^2 - \frac{1}{2}r[\beta_1^2\sigma_{1q}^2 + \eta^2\sigma_2^2 + \delta^2\beta_2^2\sigma_{2q}^2] \\ & - \frac{1}{2}(1 - \delta)r\beta_2^2\sigma_{2q}^2 + \text{constants.} \quad (A1) \end{aligned}$$

PROPOSITION 1. *If satisfaction can be measured costlessly, it is better to reward on both satisfaction and volume than on volume alone.*

PROOF. By optimality, it is weakly better to have the option of regulating both β_1 and η . As the following results will show, η is not a constant function of the parameters and therefore zero at most on sets of zero

measure (in parameter space). Since the parameters of the model satisfy the second order conditions, there is a unique optimum. Thus a non-zero η implies the improvement is non-zero. \square

To prove the rest of the propositions we need some preliminaries. The first order conditions are:

$$\begin{aligned}\frac{\partial \pi}{\partial \eta} &= [-(3 + 8r\sigma_s^2)\eta - 3\delta\beta_2 + 2]/8 = 0 \\ \frac{\partial \pi}{\partial \beta_1} &= [-(3 + 8r\sigma_{1q}^2)\beta_1 + 2]/8 = 0 \\ \frac{\partial \pi}{\partial \beta_2} &= [-3\delta\eta - (3\delta^2 + \{1 - \delta + \delta^2\}8r\sigma_{2q}^2)\beta_2 + 2\delta]/8 = 0.\end{aligned}\quad (A2)$$

Using the implicit function theorem on the first and third of these we know that $d\eta/d\phi$ is given by:

$$\frac{d\eta}{d\phi} = -\left[m_{11} \frac{\partial^2 \pi}{\partial \eta \partial \phi} + m_{12} \frac{\partial^2 \pi}{\partial \beta_2 \partial \phi}\right] \quad (A3)$$

where $\{m_{ij}\}$ is the inverse of $\{\partial^2 \pi / \partial u_i \partial u_j\}$, $(u_1, u_2) = (\eta, \beta_2)$, and ϕ is an arbitrary parameter. If $|M|$ is the determinant of this inverse, these reduce to:

$$\begin{aligned}|M|m_{11} &= -(3\delta^2 + \{1 - \delta + \delta^2\}8r\sigma_{2q}^2)/8 \\ |M|m_{12} &= 3\delta/8\end{aligned}\quad (A4)$$

From the second order conditions we know $|M| > 0$.

PROPOSITION 2. $d\eta^*/d\delta < 0$.

PROOF. (a) (A3) gives:

$$\frac{d\eta^*}{d\delta} = -\frac{\partial^2 \pi}{\partial \eta \partial \delta} m_{11} - \frac{\partial^2 \pi}{\partial \beta_2 \partial \delta} m_{12}.$$

Direct calculation reveals that:

$$\begin{aligned}\frac{\partial^2 \pi}{\partial \eta \partial \delta} &= -3\beta_2/8 \\ \frac{\partial^2 \pi}{\partial \beta_2 \partial \delta} &= [2 - 3\eta - (6\delta + \{2\delta - 1\}8r\sigma_{2q}^2)\beta_2]/8\end{aligned}$$

using $\eta > 0$, $|M| > 0$, and substituting β_2 from the first-order conditions we see (after some calculation) that $d\eta^*/d\delta < 0$. The profit impact depends upon the net effect of customer satisfaction as a means to pay today for enduring effort and customer satisfaction as a source of information about future sales. \square

PROPOSITION 3. (a) $d\eta^*/d\sigma_s^2 < 0$. (b) $d\pi^*/d\sigma_s^2 < 0$.

PROOF. (a) Using (A1) and $|M| > 0$:

$$\frac{d\eta^*}{d\sigma_s^2} = -\frac{\partial^2 \pi}{\partial \eta \partial \sigma_s^2} m_{11} < 0.$$

(b) By invoking the envelope theorem, we show this by direct differentiation of (A1). \square

PROPOSITION 4. If rewards are linear in \tilde{s}_a , rather than \tilde{s} , then q_r , \tilde{s} , and π are lower.

PROOF. Fix a finite cutoff quantity. For all $j \in \mathbb{R}^+$, if the employee group puts effort levels $\bar{a}j^{-1/2}$, $\bar{b}j^{-1/2}$ on a set of customers with measure j and zero on the remaining $(1-j)$, the effort costs are $\bar{a}^2 + \bar{b}^2$. The employee group's valuation of expected pay is: $\beta_1(\bar{a}j^{-1/2})j + \eta(\bar{b}j^{-1/2})j + \delta\beta_2(\bar{b}j^{-1/2})j$ plus terms not involving (\bar{a}, \bar{b}, j) and its risk costs are $\frac{1}{2}r\sigma_s^2 j^{-1}$ plus terms not involving (\bar{a}, \bar{b}, j) . For any level of effort cost, the employee group can maximize expected pay, less the cost of risk, by letting j go to zero. This will reduce q_r , \tilde{s} and π . \square

PROPOSITION 5. If the satisfaction of a segment with measure h can be measured with variance σ_h^2 and the satisfaction of the remaining $1-h$ customers can be measured with variance $\sigma_{1-h}^2 > \sigma_h^2$, then profits improve if a greater weight is placed on \tilde{s}_h and a non-zero weight is placed on \tilde{s}_{1-h} .

PROOF. The optimality of a linear scheme in two measures follows directly from Holmstrom and Milgrom. By Proposition 3, a greater weight should be placed on the measure with least variance, and by Proposition 1,

no weight should be zero except on a set of measure zero. Strict improvement follows from the second-order conditions. \square

PROPOSITION 6. *If it takes less effort to get equivalent sales from each customer in a segment of measure l than from the remaining customers (measure $1 - l$), then the firm can improve its profits by rewarding the sales and satisfaction for each segment differently.*

PROOF. The optimality of a linear scheme in two sets of measures follows directly from Holmstrom and Milgrom. Let the purchase quantities for customers in each segment be defined as (where $\tau < 1$):

$$\bar{q}_{1c}^l = 1 + \bar{e}_{1c} + a_c^l - p_1$$

$$\bar{q}_{1c}^{1-l} = 1 + \bar{e}_{1c} + \tau a_c^{1-l} - p_1$$

$$\bar{q}_{2c}^l = 1 + \bar{e}_{2c} + b_c^l - p_2$$

$$\bar{q}_{2c}^{1-l} = 1 + \bar{e}_{2c} + \tau b_c^{1-l} - p_2.$$

Allowing the employee group to discriminate between customers in the different segments and the firm to charge differential weights results in the following profit function:

$$\begin{aligned} \pi = & p_1[l\bar{q}_{1c}^l + (1-l)\bar{q}_{1c}^{1-l}] + p_2[l\bar{q}_{2c}^l + (1-l)\bar{q}_{2c}^{1-l}] - l[a_1^2 + b_1^2] - (1-l)[a_{1-l}^2 + b_{1-l}^2] \\ & - \frac{r}{2l}[\beta_{1,l}^2\sigma_{1q}^2 + \eta_1^2\sigma_1^2 + \delta^2\beta_{2,l}^2\sigma_{2q}^2] - \frac{r}{2(1-l)}[\beta_{1,1-l}^2\sigma_{1q}^2 + \eta_{1-l}^2\sigma_1^2 + \delta^2\beta_{2,1-l}^2\sigma_{2q}^2] \\ & - (1-\delta)[\alpha_2 + \beta_{2,l}q_{2c}^l + \beta_{2,1-l}q_{2c}^{1-l}]. \end{aligned}$$

As the parameter τ does not drop out of the first order condition with respect to η_{1-l} it will affect the optimal incentive weights (except at most on sets of zero measure). Strict improvement follows from the second-order conditions. \square

PROPOSITION 7. *If consumers in segments l and $1 - l$ have different switching costs then their satisfaction should be weighed differently and the higher the switching costs the lower the weights.*

PROOF. Since the second part of the proposition implies the first we only prove the second part. In a two period model, higher switching costs mean that first period sales are more valuable because they make second period sales easier to achieve. This can be captured by scaling first period profits. The relative preference for first or second period profits is represented by the rate at which profits are discounted in the second period. Discounting the firm's profits more in the second period increases δ (recall that δ represents the employee group's discount rate given that the firm's discount rate is normalized to one) and by Proposition 2, an increase in δ reduces the weight given to customer satisfaction in the incentive scheme. \square

PROPOSITION 8. *If satisfaction with the competitor's product can be measured costlessly, it should be incorporated into the incentive system whenever the correlation between the measures, \tilde{s} and \hat{S} , is non-zero.*

PROOF. By direct application of the Holmstrom (1979, p. 84) result that more information, beyond that obtainable with \tilde{s} , improves the ability of the firm to design an incentive system. \square

COROLLARY. *If the firm uses disaggregate measures of satisfaction, matched to the enduring efforts of each employee, to enhance precision (reduce σ_s^2) relative to aggregate measures, the firm (a) will weight the disaggregate measure more than it would have weighted the aggregate measure and (b) profits will increase.*

PROOF. By assumption σ_s^2 decreases, thus the corollary follows directly from Proposition 3. \square

List of Symbols

a	ephemeral effort (can vary by customer)
b	enduring effort (can vary by customer)
c	representative customer (actually integration over dc)
e	error term of variable. Subscripts indicate which variable.
g	the firm's initial reputation
h	measure of segment in Proposition 5
j	measure of segment in Proposition 4
ℓ	fraction of customers who are loyal (higher switching costs)
l	measure of segment in Proposition 6
$M(m_{ij})$	matrix (elements of), in Appendix
p	price
\bar{q}	quantity sold

r	coefficient of risk-aversion
$\tilde{s}(\tilde{S})$	measured satisfaction (of competitor or other benchmark)
$U(\cdot)$	employee utility
U	base wage
w	payment to employee group ($\hat{\cdot}$ indicates candidate rewards)
α	constant parameter in incentive system
β	sales volume parameter in incentive system
δ	employees discount factor
η	satisfaction parameter in incentive system
π	profits
ρ	correlation
ζ	weight on competitive satisfaction (or other benchmark)
σ^2	variance (subscripts indicate specific variances)
ϕ	arbitrary parameter in Appendix
τ	scale for effort of the non-loyal customers (Proposition 6 in Appendix)

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